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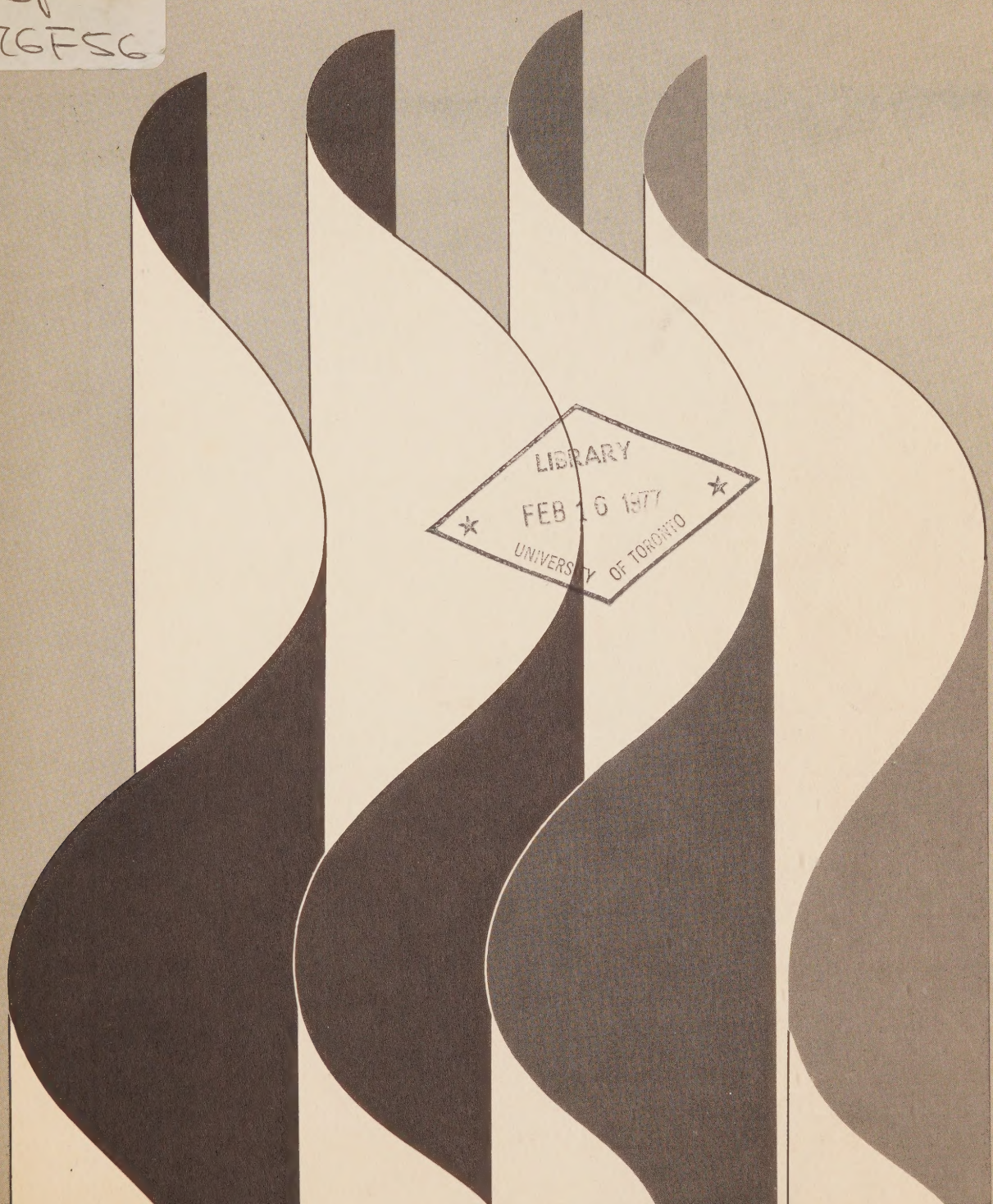
Fourth–Quarter Century Trends in Canada



FOURTH-QUARTER CENTURY TRENDS IN CANADA

Fisheries and Environment
Canada

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SUMMARY

I. INTRODUCTION

Purpose

Fourth-Quarter Century Trends in Canada is an analysis of the significant interrelated factors which affect environmental management. The primary purpose of this document is to serve as an information base and reference source from which future planning alternatives for the department may be obtained and their environmental consequences examined.

Methodology

The study used a methodology which identified some of the significant factors in Canada's social, economic and environmental development, analyzed past trends and looked at future alternatives. Population and demographic growth, urbanization and economic activity are seen as dependent upon and being affected by physical/environmental resources (renewable and non-renewable) and energy.

In order to anticipate future needs in the area of environmental policy, a summary of current trends and projections in various sectors was summarized from existing information sources. To ensure flexibility, the major sectors (population, urbanization, economic activity) were viewed in terms of alternative ways the sectors could develop. The environmental implications arising from these alternatives were then examined.

The various sectors (population, resources, energy, etc.) were linked and integrated, so that broader environmental policy directions could be brought into proper focus. The conceptual framework for linking these sectors is presented in Figure 1. The key relationships and interactions highlighted by this schematic presentation are:

1. Human activities that impact on the physical environment.

   Human activity serves as a focus of dynamic sources of pressure on environmental resources (excluding natural environmental effects and cycles) through:

   (a) Size, composition, and dynamics of population; (Chapter 1)

   (b) Distribution of urbanization, association urban form, and key urban infrastructures; (Chapter 2)

   (c) The complex of economic activities, in terms of mass, structure, internal dynamics (relationship among sectors; multiplier and spillover effects), regional relationships, and pace of development over time (rapidity of turnover of activity, replacement and addition of economic infrastructure). (Chapter 3)

2. The resource environment, as a sustaining "pool" for human activity over time.

   The resource sphere constitutes the target for human activity inasmuch as it provides:

   (a) The basic life-support system - land, water, and air;

   (b) Non-energy resources (e.g., materials both renewable and non-renewable) which are used and transformed to support human activity; (Chapter 4)

(c) Energy resources (the basic support system for effecting the transformation of resources to support human activity) (chapter 5)

3. The adjustment and management of relationships between human activities and the resource environment, by means of a number of activities that involve foresight, planning, reaction to events, and the development and implementation of policies, strategies and tactical approaches.

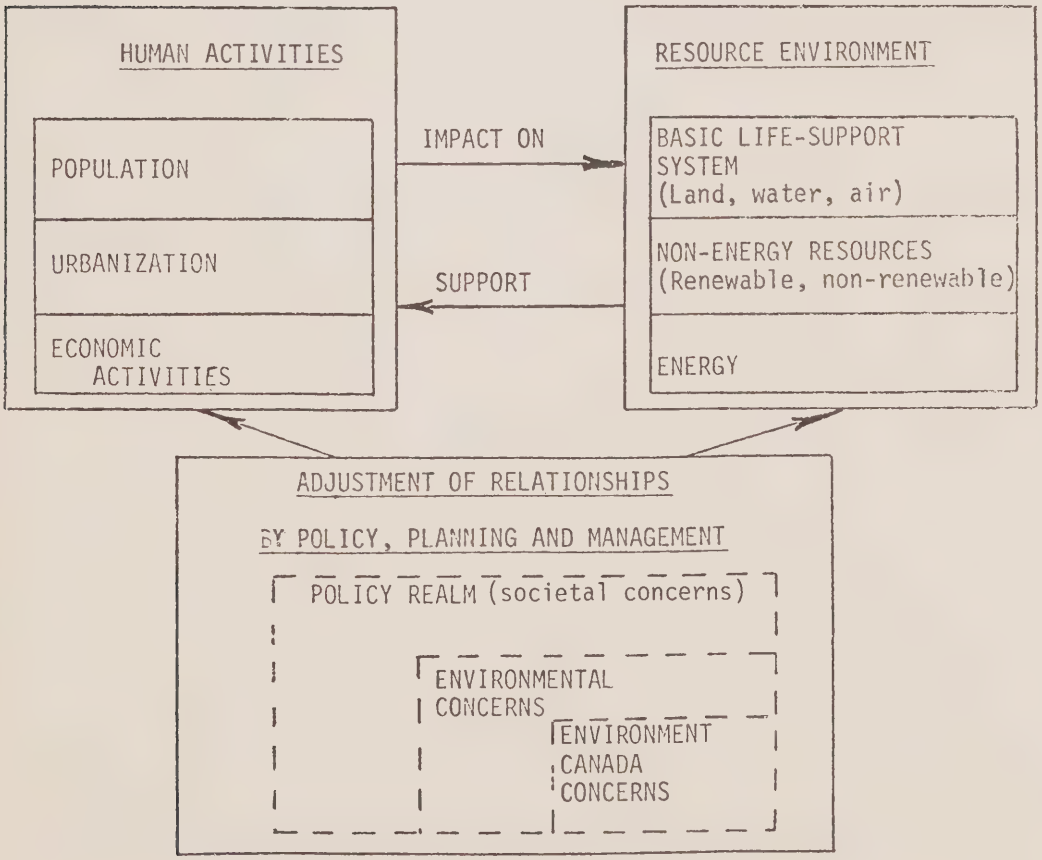

FIGURE 1.

RELATIONSHIP BETWEEN HUMAN ACTIVITIES AND THE RESOURCE ENVIRONMENT

Environmental Implications

Both direct and indirect implications need to be considered when examining the environmental implications arising from the interaction of the sectors. Direct environmental implications are those for which environmental policy decisions will have to be made. Indirect environmental implications are those which call for decisions to take into account environmental concerns. An example of a direct environmental implication would be increased water pollution associated with more intensive approaches to maintaining or expanding the food supply. An example of an indirect implication might be the importance of immigration as a factor in population growth, since immigration policy has a bearing on the growth and distribution of Canada's population, which in turn has environmental consequences.

The central concern of policy for resource management is the management and adjustment of interactions between human activities and resources. Given anticipated developments in the Canadian economy and society, future impacts will intensify and interactions will become more complex. Management responsibility in areas of direct environmental impacts will need to be supplemented by increased attention being given to influencing those wider areas of human activity that have profound effect on the environment. The requirement to manage the timing, scale, and type of development lies at the heart of the balancing problem, whatever techniques are used. One has to decide whether to speed up or slow down rates of growth in various sectors; how to balance these sectoral growth rates in a comprehensive fashion. In addition, one has to make certain that one retains the option of making

the system more stable over time than it would have been in the absence of policy interventions. These questions relate to supply. There is also a recognized need to influence the demand side of the equation (i.e., cutting down rate of energy consumption by conservation or other measures) to bring it more in balance with a preferred or necessary rate of development.

A general conclusion is that fourth-quarter century trends in Canada will require a greater capacity to manage crises, more and better policy at the margin, e.g., water pollution control, as well as new initiatives in comprehensive and integrated planning and management, e.g., management of the urban environment. However, the relative balance in this overall policy mix will also be affected by the ways in which trends interact.

The trends and their implications are summarized under the following headings:

II SECTORAL TRENDS

II.1 Population and Demographic Growth

The component method is used in this document to project and forecast future population trends in Canada. Two sets of population scenarios for the next quarter-century are presented on the basis of defined mortality, fertility and migration assumptions.

Canada's population is projected to grow to the year 2000 by between 35 and 60% to a corresponding range of 31-36 million. Of this growth, immigration emerges as a significant component of the increases projected (amounting to 50% or more). (Figure 1.2)

The age-sex structure is another aspect of the demographic picture which determines the future population trends. The relative size of the various age and sex groups has considerable significance for a population's productivity, standard of living, cost of educational and welfare programs, degree of racial and ethnic integration, impact on urban and rural ecosystems and the achievement of national, social and economic goals in general. A significant change in the age structure is projected to take place in the next quarter century. The ratio of aged to children will double (0.27 in 1971 to 0.55 in 2000); 10-13% of the population will be 65 and over (from 8% in 1971); and about 20% will be under 15 (a decrease from 30% in 1971).

The document includes an examination of the regional distribution of these age groups and the implications of the changing demographic picture in Canada.

Arising from the demographic picture, the environmental policy concerns centre upon the overall pressure on the physical environment and its carrying capacity. This pressure arises from age structure, distribution and activities of the future population. These factors will need to be considered if an optimal population size for Canada is to be determined.

II.2 Urban Settlement Patterns

It is estimated that between 1975-2000, urban facilities will be needed for another 11-15 million Canadians. The basic question of future urban growth is its geographical distribution. Two options are discussed in this document. First, if present settle-

ment trends continue with no extensive policy intervention, there will be a numerically disproportionate distribution both regionally and provincially. Seven of the 22 Census Metropolican Areas (CMA's) will increase their populations by more than 50%; Calgary alone is expected to grow by 137% (See Figures 2.1 and 2.2). On a provincial level by 2001, British Columbia, Alberta and Ontario are estimated to contain 65.6% of the Canadian population with Ontario alone containing nearly 43%. From 1971 to 2001, the provinces of Saskatchewan, Manitoba, Quebec and the Maritimes are expected to decline relatively.

Option two - preservation of 1971 provincial population proportions - would require extensive policy intervention. Although major CMA's would still grow absolutely, urban settlement would be redirected to secondary centres outside British Columbia, Alberta and Ontario.

A key question regarding urban expansion is that of the "urban fringe" and land use. Calculations indicate that between about 7100 and 15,000 square miles of territory surrounding urban areas would be transformed to urbanized land over the next 25 years. Much of this would be prime agricultural land. However, expansion of smaller urban centres (non-major CMA's) consumes relatively more land. Unless active policy intervention takes place in land use, it appears preferable to encourage greater density in large urban areas, or to encourage growth in centres which are not on agricultural land (i.e., Halifax). In addition to loss of agricultural land, low density-suburban communities have consistently

paid less in municipal taxes than they have received in services. Rapidly rising expenditures may place many urban areas in an increasingly precarious financial position, as local governments receive a decreasing proportion of indirect taxes (from 5.4% in 1964 to 4.3% in 1974). Every major city in Canada has experienced deficits over the last three years. Rationalization of tax resources will become necessary, not only among governmental jurisdictions (Federal, Provincial, and Municipal), but also within many urban centres themselves (e.g., possible taxing of "vacant" urban land such as parking lots, as if it were occupied by buildings in order to encourage efficiency in land utilization while increasing tax resources).

Recreation and tourism has become a relatively new (20 years) "growth" industry. As the population grows and more Canadians become urbanized, the demands for and strains on recreational areas and facilities are likely to increase. By 1970, tourism alone represented the third largest industry in Canada in terms of gross sales.

The need for wilderness and open space in and around urban areas is expected to more than double. At present, Quebec with 28% of the population contains over 50% of the park area while Ontario, with 36% of the population, contains only 4.5% of the park area; however, these areas are not all in urban proximity, or may be difficult as to access.

Transportation may be the most important link in the pattern of future urban growth. For example, the ten years from 1961-71 saw

car registrations increase at 6.5% per year, far outpacing population increases. The Transportation Development Agency sees the automobile as the dominant form of transport in Canadian urban centres in the year 2000 (92%), despite the fact that mass transit uses less than half the energy per passenger-mile (Table 2.9, Appendix B). Increased urban density to control land use and loss of agricultural land could make mass transit economically more feasible in future.

Intercity automobile travel, currently 85% of all passenger miles travelled, takes productive farmland out of service as well as straining intercity road networks. Bus and rail, while less speedy and convenient, consume less energy and cause less urban disruption than either automobile or air travel.

Water transportation is expected to impact more on the environment. Increased oil needs and national resource exploitation (fishing, forestry, oil, gas, minerals, etc.) would increase needs for new and expanded marine terminals (petroleum products, primary cargo, general cargo, containers). In addition, urban and associated industrial growth would impact on 14 of the 22 CMA's which have direct access to water (they contain 80% of the CMA's population).

Wastes. The question of propertly controlling wastes is rapidly increasing in importance because urban growth encourages and is stimulated by industrial activity. The minerals sector produces 65.4% of the total tonnage of rejected material and waste, agriculture 30.5%, and industrial and municipal wastes the remaining 4.1%.

However, the tonnage figures may be misleading in terms of impact on the environment. Mining wastes, although large in tonnage, may produce relatively small environmentally harmful effects in physically remote areas, i.e., silting of water courses, acid drainage, etc., while industrial and municipal wastes may contain harmful and even toxic substances (i.e., mercury, lead, cadmium, etc.) in areas of major population concentrations. The cost of handling municipal wastes is expected to triple by 2001. Already many cities face problems finding suitable land-fill sites, many for political reasons.

Demands for clean water are also rising as municipalities cope with building and upgrading sewage treatment facilities (66% of the urban population is served by some form of advanced sewage treatment at present).

It is estimated that air pollution can grow as the population grows. However, technology exists to greatly reduce, if not almost eliminate, particulate emissions, and to reduce others to tolerable levels (air quality in many major urban centres has improved in the last five years). Some scientists are concerned that a tripling of carbon dioxide production by 2000 could be harmful to the earth's atmosphere. New hazards such as chemically-active air pollutants, acid-rain, freons, etc., require further study.

In the urban settlement areas, specific environmental concerns focus first on the desired rate of growth of urban centres, where settlement should be encouraged and how. Continuation of present growth trends could overload the carrying capacity of certain regions

such as the lower mainland of B.C., and the "Golden Horseshoe" area of Ontario. Re-direction of urban growth to alternate centres may generate as many problems as it solves (e.g., Pickering, Nanticoke).

Urban population densities need to be studied in the light of higher per capita land consumption in smaller urban centres as compared to major urban centres. Various questions of trade-offs arise here such as: (1) should larger urban centres be encouraged? (They use less land per capita, may make control over environmental quality easier to manage in some sectors, in some centres may provide potential efficiencies in transportation and recreational services, etc.); or, should the approach be to encourage higher population densities in all urbanized areas or only in urban areas which do not infringe on agricultural land? (2) Should recreational land be developed at the urban fringe, or in central core areas where higher population densities are encouraged over time, etc.

Which modes of urban and intercity transportation should be encouraged to support future urbanization and settlement patterns? What new technologies are required to enhance the urban environment? What legal, jurisdictional, and fiscal changes need to be brought about to assist in the rational control and planning of future urban growth and development? These are but some of the questions that need to be addressed.

Future needs for waste management will become increasingly pressing over the next 25 years. Any future urbanization patterns will need new processes for handling wastes, monitoring of effects on regional environments and new methods of apportioning the costs

of waste control among the various public, as well as the private, sectors.

II.3 Economic Activity

A brief historical overview of Economic Development in Canada since 1870 is presented as a backdrop for three possible future economic trends. These postulated alternatives consist of:

(1) A moderate growth trend or a continuation of growth similar to pre-recession trends (approximately 5-5.5% average annual increase in real GNP). This would yield a real GNP by 2000 between two and three times the 1975 level, with real GNP per capita increasing between 70 and 100%.

(2) A slower growth trend (4.5% p.a.) would imply incremental growth around existing urban, industrial and resource areas, problems of unemployment, energy and resource developments, competition for capital, and shifts in emphasis from more social values to more basic economic questions. Problems of future resource supplies could occur for lack of timely investment.

(3) A faster growth trend (6% p.a.) would assume a major and rapid expansion of the resource sector and would require industrial and infrastructure growth on a large scale to support such developments. This alternative would produce industrial population shifts to the west of the Windsor-Quebec corridor, population and economic activity pressures on capital and manpower resources, inflation, a probable need to increase immigration, increasing pressures on the environment around urban areas, and the resource hinterland.

A fourth alternative to be found in Appendix D attempts to piece together elements of the preceding analyses and extend our thinking to the year 2000 by elaborating one of many possible developmental paths. What is suggested is a rate of growth that increases under the stimulus of high resource demand and low population growth, peaking at an average rate of 6% by the mid-1980's and then gradually declining to a 4.5% annual rate of increase in real GNP in the closing years of the century. On average, according to the trajectory that is considered, the rate of growth would be about 5.3% per year, in real terms.

Environmental policy concerns arising from variations in economic activity are numerous and complex. Consistent with a slower growth trend over the next decade, increasing attention would be paid to purely economic matters (i.e., unemployment, industrial growth). This would probably mean increasing difficulty in developing needed initiatives in environmental concerns, increasing difficulty in funding environmental programs, and pressures for not expanding existing environmental regulations and programs which are related to industrial and resource extraction activities. Probably a "stand-pat" stance would occur in environmental matters and incremental changes in policy would probably be adequate. Indirect policy intervention into areas other than direct environmental concerns would probably be minimal. However, such "negative" outgrowths from a slower rate of growth would be to some extent mitigated through reduced rate of growth of pressures on the environment due to lower relative rates of growth of dis-

posable income, development capital, building of new facilities, etc.

If the growth trend of the economy accelerates, the anticipated development of the non-renewable resource and energy sector would shift some of the environmental focus to the resource areas, especially the north and west. This raises the questions of possible new initiatives in this area, the probable need to streamline and expand environmental assessment procedures, and a possible change of focus to overall resource management. Rapid industrial growth would raise questions of the need for more stringent pollution controls, especially in and near urban areas. Financing of environmental initiatives would be relatively easier, and handling costs of pollution control probably more tractable.

If the economy develops as in the mixed growth rate alternative (faster growth rates tapering off to the year 2000), sufficient resources and lead-times would probably exist to allow a reasonable level of environmental initiatives to be taken. This would also allow policy intervention in many indirect areas of concern to the environment, as well as the development of a more resource-management focus.

Over the next 25 years, problems of energy supply and supplies of some raw materials are expected, irrespective of which economic growth alternative would occur. This implies increasing pressure for resource development. This, in turn, raises questions of handling such developments in an environmentally acceptable manner. Increases in per capita GNP and changes in age structure could

lead to changing consumption patterns: a relatively older (slow to medium economic growth) population may lead to a shift to higher-priced services, demand for more recreational and leisure facilities (up to a possible "saturation" level), and changes in overall consumption patterns.

Irrespective of growth rates, regional competition and tensions are likely to increase, especially under conditions of rapid development of energy and raw material resources with its attendant shifts in capital, population and economic activity. The increasing competition for capital over the next 25 years may lead to problems of adequately funding long-term environmental programs.

II.4 Resources

While economic activity is based on the exploitation of resources, there is a growing awareness of the costs of unplanned resource extraction, in both the short and longer term. Over the next 25 years, it is anticipated that questions of land and water use conflict will grow (mainly among agriculture, cities, industry, recreation). This raises questions of injecting environmental concerns strongly into new areas such as urban population and growth, recreation, agricultural development, expansion of marginal lands (for agricultural use), use of chemicals and energy in agriculture, waste water treatment and recycling for industry and agriculture, new management techniques and philosophies for renewable resources such as fisheries and forestry, etc.

Agriculture. World food shortages are likely to persist for some time, making Canada's agricultural capacity an important

renewable resource. But Canada's best agroclimatic soils are threatened by urban development. Williams (1975) estimates that 81% of the urban population lives on or near 66% of the best Canadian farmland. Competition for water resources is also likely to grow in future. Attempts to intensify agricultural production or increase acreage through irrigation can clash with municipal and industrial needs. Energy costs will also raise the price of Canadian food. MacEachern (1973) calculated that 30 cents of energy (direct and indirect) were purchased by farmers to produce $1.00 of output. The long-term effect of possible climatic change, although noted, requires further study, particularly for its impact on food production. In addition, future studies of the long-term effects of chemicals on biological organisms, (including man) are necessary, as well as such questions as devising adequate assessments of new chemical products introduced into the environment, etc.

Fisheries. Long-term resource management is more clearly perceived in this area. The effects of water pollution (both of the oceans and inland waters) will require continued monitoring. Fish as an alternative protein source has been efficiently managed by many countries. Canada's total fish catch continues to decline although some protected species (West Coast herring) are returning. The development of new techniques of fisheries management will become an important issue in future policy development, if continuing supplies for growing domestic and foreign markets are to be ensured and other social objectives are to be satisfied. This would include questions such as: should Canada continue to utilize the

concept of "maximum sustainable yield," or modify it to satisfy domestic, social and/or economic objectives, such as using fishing to sustain historical communities and preserve a "way of life" in certain areas, or to maximize fishing income for a smaller number of fishermen, etc.

Forestry. The world demand for forest products is expected to increase 50% by the year 2000. The demand for Canadian exports to the United States is predicted to more than double. Whether Canada can meet this demand at present levels of forest management is dependent on many factors. Intensified forest management (insect, disease and fire control, fertilizing, thinning, etc.) have spillover effects in pollution control costs, land and water management. In addition, alternate or multiple use of forest areas often conflict with logging operations. Over the next quarter century, more serious questions will arise in forestry over such matters as increased production, forest management, more efficient use of wood product recycling, long-term effects of monoculture, conflicts over production and recreational usage of forests, etc.

Minerals. The expected rapid expansion of mineral production raises questions of environmental quality at all stages of extraction and processing. How much production and domestic processing should be expanded to meet export demands and contribute to export earnings will have to be balanced against increasing pressures on the environment, the costs of pollution control and abatement, and the threats to health of refining processes, the latter often being situated close to urban centres.

Crude and fabricated minerals represent about 20% of Canada's exports of $25.2 billion (1973). Canada ranks third after the U.S., and the USSR in terms of world mineral production. Some minerals have shorter "life-times" than others: six commodities (copper, lead, molybdenum, nickel, sulphur and zinc) will last roughly 20-30 years if no new resources are developed. While Canada can supply most of its domestic needs for the foreseeable future, new deposits will have to be developed, starting in the late 1980's. A key requirement will be to find and develop new uranium sources. Exploitation of high cost, low-grade ores and expected increases in domestic processing and refining will increase conflict over environmental and health protection in the future.

II.5 Energy

For Environment Canada, there are many concerns related to energy supply and demand. This ranges from the environmental impacts of hydroelectric power developments to the siting of nuclear power stations; from open pit coal-mining to tar sands development; from pipeline and electricity transmission lines to oil and gas tanker terminal sitings (Termpols); and from thermal pollution at power-generating stations to gaseous emissions from transport vehicles and stationary sources.

The underlying assumptions of federal energy policy postulate some basic continuation of historic trends. Fundamental changes are difficult to foresee or predict. Consequently, the scenario centres on the delineation of a "base case" projection, built on extrapolation of past trends with minor modifications, allowing

some scope for examining the implications of wider deviations from existing trends. The implications of rapidly changing estimates of domestic oil and gas reserves are noted, but not explored (i.e., decreasing domestic reserve estimates can lead to larger imports, necessitating new and expanded marine oil terminals, etc.). The impact of possible structural changes in the Canadian economy are seldom, if ever, explored. In discussing the environmental implications of the energy system in Canada, emphasis is placed on possible developments that may take place, but which have not been fully explored.

The base case employed in this sector consists of the scenario that if population growth and distribution follow projected trends, energy consumption will rise fourfold between 1970 and 2000; from 5×10^{15} Btu's in 1970, to about 20×10^{15} Btu's by 2000 (Table 5.1, Appendix B). This compares with an expected tripling of economic activity during the same period.

Each of the energy sectors - electricity, oil, gas, and coal, are examined in detail with reference to a "base case" projection. Table 5.2 (Appendix B) presents a forecast of energy usage for the year 2000. At present, about 80% of Canada's primary energy consumption is met by oil and gas, about 15% by electricity and about 6% by coal (nuclear and wood are about 1% each). As a "base case" approximation, it is calculated that by 2000, hydro and nuclear electricity will meet about 20-25% of the total demand, a relative increase over that presently supplied by oil and gas. (Tables 5.1, 5.2 and 5.3, Appendix B).

As we move towards the year 2000, certain general trends emerge. Generally speaking, there will be a continuing move towards an electrically-based economy. This will be accomplished by an increasing proportion of nuclear-based generation of electric power, plus some additional exploitation of potential hydro sites as well as expansion of thermo-electric generating capacity, probably fuelled primarily by coal. This implies that the relative significance of coal will continue to increase, both for electricity generation as well as other transportable energy forms (by production of liquid distillates from, and gasification of coal).

Unresolved uncertainties as to oil and gas supply will continue with estimates dependent on rates and costs of development (i.e., the 1973 NEB estimates of frontier supplies have been approximately halved by late 1975). Both additional tar sands and some frontier resources are expected to come on stream in the 1980's. Eastern Canada and British Columbia are estimated to remain heavily dependent on oil imports (perhaps as part of a Canada-U.S. "swap" agreement). A supply crisis may occur in the early 1980's prior to the coming on stream of significant new developments.

By 2000, a number of new energy technologies may be in use, ranging from fusion and solar power to increased energy use of wastes (by direct combustion or processing to say industrial alcohol), as well as specialized applications such as wind and solar technologies.

Coincident with the projected increases in energy development are numerous environmental concerns. There will be an increasing need for river basin management to control and regulate hydro-electric installations, and increased conflict over land use associated with energy development (creation of large reservoirs, petroleum exploration and energy "corridors"). The development of nuclear power is accompanied by many environmental problems such as disposal of radio-active wastes, waste heat, land and water use, and the heightened risks of potential large-scale disasters (precipitated by sabotage, etc.). The mining of coal will present unprecedented environmental problems as the mining of lower grade deposits becomes feasible; health problems associated with mineral extraction are likely to increase as well. Other looming problems consist of an increasing potential for large environmental "disasters" associated with petroleum extraction and transport and who pays for remedial action; how fossil fuel exploration, production and transport should be handled in environmentally sensitive areas, etc. In the last-named area, the expected need for the importation of offshore oil would necessitate increased tanker (and possible offshore pipeline) traffic. This would lead to a need to expand and conduct new marine petroleum terminals as well as associated land-based facilities.

Environmental damage and disruption, and possible damage to human health can result from activities associated with the production and use of energy and the waste products arising from energy conversion. However, it is expected that the environmental impact

of energy activities can be controlled at reasonable cost with present and anticipated future technology. The possible exception to this could be the question of disposal of radioactive wastes.

The estimated cost of environmental protection over the next decade will be large in absolute terms but small, relative to the total cost of energy expenditures. The estimates for ensuring environmental protection over the 1974-1983 decade range from 7-10 billion dollars.

On an aggregate basis, this would add between 5-7% to the estimated total cost of energy production and use during 1974-1983. This would represent about 0.5% of Canada's predicted cumulative GNP for that period. About 2/3 of this additional cost would be incurred in connection with the use of energy in transportation. This level of cost increase is not expected to have an important effect on the national economy or "cause a significant change in the pattern of energy use."

Table 5.8 (Appendix B) outlines estimated costs for areas and economic sectors for Canada for the 1974-1983 decade.

III ENVIRONMENTAL POLICY: 1975-2000.

Since the problems of environmental management are related to the direction and pace of change in our society, future planning will need to be flexible, experimental, adaptive and anticipatory.

Certain environmental policies already in place or in various stages of development contribute to the dynamic process of managing renewable and non-renewable resources. Perhaps the most prominent of these has been the Canada Water Act, 1970, which

visualized the comprehensive management of Canada's watersheds. Because of jurisdictional problems, however, the Act has not been fully utilized. However, recent events suggest that a more complete watershed management will soon be forthcoming. The Clean Air Act has regulations and guidelines which apply to Federal activities and financing (such as DREE grants); this allows a degree of indirect control. In addition, Section 7 of the Act allows contaminants which have been declared risks to human health to be controlled. The Contaminants Act, with its tie-in with the Department of Health and Welfare, allows certain control over the manufacture of products. The Arctic Waters Pollution Act (under the Department of Indian Affairs and Northern Development) provides effective policing of Arctic waters; the Ocean Dumping Act, covering such areas as territorial waters, fishing zones, and "adjacent waters," applies to all ships, platforms, etc., in such waters, and requires dumping permits. However, the Act excludes such activities as "normal operations" of such ships, etc., outfalls, and processing of seabed mineral resources.

While environmental legislation has had some moderate degree of success, it is nevertheless true that there has been a shift in perception in the last few years. Earlier, environmental concerns were seen solely as a constraint; today the environment is seen as one factor among others to be considered in government policy-making. Although not all segments of society are convinced of the need for specific protective mechanisms, environmental impacts can no longer be ignored in future development of Canadian society and policy formulation.

What are the future policy implications for environmental management arising out of perceived environmental concerns? Disregarding jurisdictional questions which have not been discussed in this document, some issues emerge from the document which suggest the course of future policy development either directly or indirectly. These issues can be summarized (not necessarily in terms of time spans or priority) as:

1. The overall level and structure of population growth.

2. The patterns of population distribution, regional population growth, urbanization, urban patterns, the urban environment, and environmental health.

3. The patterns of land use which optimize or maximize public expectations in terms of social needs (such as recreation) and competing demands (such as urbanization versus agriculture, etc.).

4. The development and rationalization of transportation, considering such areas as: effects on population distribution, changes in social needs and impacts on them, needs for economic and resource developments, energy use and conservation, environmental quality, etc.

5. The alternative rates of economic growth as scenarios and their implications (including certain technological developments).

6. The development of renewable resources, considering the concept and limits of maximum productivity versus long-term optimum sustainable yield (central to food, fisheries and forestry management), as well as that of substitution (species and products) and social aspects.

7. The future development of Canadian mineral resources in the light of long-term security of supply, domestic processing, environmental concerns, and export revenues.

8. The future growth and development of the energy sector, considering such aspects as a rational energy mix versus overdependence on any single energy technology, competing energy uses, associated environmental impacts, energy conservation, etc.

9. The evaluation of the long-term effects of dynamic natural environmental patterns and cycles (such as changing climatic patterns and their effects on food production, urban needs, population distribution; "natural contaminants" in the environment, etc.), as compared to man-made impacts (such as: man-made contaminants, environmental health, effects on physical environment of such things as freons, etc.

In addition, the direction and pace of future Canadian development will require a change in focus from sectoral environmental management to total resource management. New structures and policy instruments need to be devised so that environmental concerns are integrated in all areas of policy planning. A shift to longer term, integrated planning, as compared to crisis management or incremental approaches, will help to ensure that the future growth of Canada preserves and enhances our life-support systems.

With a view to the future, governmental policy planning for resource management should be considered within a framework of regional environmental needs and the "boundaries" of "natural" ecosystems; and the associated jurisdictional challenges must be incorporated into the required formulae for future environmental problem solving.

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APPENDICES

INTRODUCTION

(a) PURPOSE OF THE DOCUMENT

This document has been prepared by Environment Canada as a background paper to aid in the formulation of planning assumptions for the next 10 years. It attempts to provide an information and reference source for considering possible future planning alternatives for the department in the development of its Planning Guidelines.

The study examines trends in various sectors of Canadian society, discusses significant relationships among sectors and highlights environmental concerns. This overview is intended to provide a structured framework for examining alternative trends, so that:

1. consistent sets of planning assumptions can be developed for the next decade in the light of most plausible future trends in various sectors, *which are relevant to environmental concerns and the Departmental mandate.*

2. existing programs can be adjusted, or new ones established, within the framework of the sets of planning assumptions.

3. future policy "directions" can be developed, consistent with:

   (i) Government policies under review as contained in Sections 5 and 6 of the Government Organization Act, 1970.

   (ii) The Government Priorities Exercise.

In addition, the document is also intended to serve as a focus within the Department for systematically developing and refining alternatives relevant to departmental planning, both internally and in cooperation with other departments and agencies.

(b) APPROACH AND STRUCTURE OF THE DOCUMENT

The study uses data and material of past trends, as well as relevant future projections in the chosen sectors culled from various sources. Where necessary for completeness and consistency, some analysis and modification of existing material has been made. As far as possible, assumptions are made explicit. Discussion of trends and alternatives is included, to allow as comprehensive an analysis as possible.

In some cases, alternative development patterns are suggested or examined; in others, projections of present trends are offered as a stimulus to thinking about the implications, environmental and other-wise, of a continuation of current activity. Time frames do not always coincide; data bases have been

chosen from a variety of sources, and future estimates often rest on some unexplored assumptions. However, these admitted weaknesses serve to emphasize the very real uncertainty that exists in considering possible future options and time frames for Canadian development.

For the purposes of analysis, the various socio-economic facets of Canadian society are broken down into broad "sectors." These are:

- Population growth and demography
- Urbanization
- Economic growth
- Resources
- Energy

The rationale for these divisions is that environmental concerns emanate from people - their numbers, distribution and activities, and the impact of these factors on life-support systems. Within the sectors described future trends are postulated and their implications for environmental management discussed.

The final chapter looks at the interdependency among sectors in as comprehensive a manner as possible, given disparate information bases and assumptions. Some possible policy implications are outlined in the form of broad concerns and questions relating to Canada's environment over the next 25 years.

In summary, Fourth-Quarter Century Trends is designed to stimulate thinking about possible avenues available in policy planning. It attempts to provide the latest information available to the researchers in certain important areas of policy development with some of their impacts spelled out. Much of the material will already be familiar. Many readers will have more detailed knowledge of certain sectors. What has been attempted here is the integration in a single document of some interrelated factors affecting Canada's future development. Limitations of space and time prevented the inclusion of other significant issues such as value changes, technological developments, etc. The study is therefore intended to be suggestive, rather than exhaustive. It is for the reader to decide if this document is useful in developing new approaches to our long-term management problems.

Finally, trends do not necessarily imply destiny, nor projection curves a self-fulfilling prophecy. Where present trends imply deterioration in the health and well-being of Canadians or their environment, prescriptive planning can mitigate damage or enhance quality of life. To achieve this requires, first of all, not the search for right answers, but asking the right questions. It is hoped that this document will contribute to that end.

FOURTH-QUARTER CENTURY TRENDS IN CANADA

1. POPULATION GROWTH

(a) INTRODUCTION

Population growth and distribution comprise two fundamental dimensions of change in Canadian society. The former factor, which has been continuously cited by those concerned with the environment and the conservation of natural resources largely consists of forecasting the probable future size of Canada's population. There exists little opposition to the concept that the problems encountered in managing our ecosystem are, to a considerable extent, those created by the growth, size, and distribution of the population. The question so longer remains *whether* ecological environment and population are linked, but rather *how* are they linked, *what* are the effects of population on the environment and vice versa, and how can these factors and effects be modelled, measured, and used predictively.

The "component" method is used in this document to project and forecast Canadian population trends. That is, each of the "components" of population change - fertility, mortality and migration - is examined separately. Individual assumptions are made about each of the three variables and projections of the future population by sex and age distribution are generated from a base population.

It is generally accepted that population forecasting based on data of past and current trends, is unrealistic for periods beyond fiften years. However, speculation of the potential for population growth in Canada under several assumed levels of fertility, mortality, and migration can be useful in sketching the longer term picture. The projections contained in this document are in no sense predictions, but show what the future growth and distribution will be under the stated assumptions.

(b) UNDERLYING ASSUMPTIONS

(i) Mortality Assumption:

The mortality assumption used is a modified version of the Statistics Canada and Green Paper on Immigration assumptions.(1) Based on recent experience in Canada and other countries, the expectation of life at birth is assumed to rise by 1986 to 70.2 years for males, and 78.6 years for females. Beyond 1986, however, a more optimistic picture has been assumed forecasting "steady progress in increasing life expectancy" (based on calculations to 2071). (2)

This mortality assumption has been included in Table 1.1(Appendix B) because of its possible implications for:

a) the age-sex structure (many more aged women),

b) the distribution problem (certain population centers with large proportions of elderly people),

c) the economic costs of social and welfare support for increased numbers of aged if present trends were to continue.

Table 1.1 outlines the mortality assumptions used in this document.

Table 1.1. AVERAGE LIFE EXPECTANCY AT BIRTH

1931-2000 (years)

	1931	1966	1986	2000
Males	60.0	68.8	70.2	76.7
Females	62.1	75.2	78.6	84.5

(ii) Fertility Assumption:

The general consensus of existing literature is that, in the long run, there will be a stabilization of family size to something in the vicinity of what is called the "replacement level." In Canada at present, this represents 2.1 children per family

Future trends in fertility are extremely uncertain (given the wide fluctuations of the past 50 years). However, fluctuations within a narrower range are postulated and three alternative assumptions have been used in the projections, ranging from a gradual decline to 1 8 births per woman, to 2.1 and 2.6 births per woman. (2.1 and 2.6 births per woman represent two-child and three-child families respectively). The present fertility rate (1974) in Canada is approximately 1.87.(3)

While the three alternative fertility trends represent the "most likely" range, a further significant drop in fertility rate to 1 6 or 1.5 cannot be ruled out altogether. Short term problems of the economy, unemployment, housing scarcity, and/or changing life styles may lead the 15-40 group to postpone or ultimately opt out of child bearing. Any further drop in the fertility rate in Canada will increase the age-dependency ratio (see p.5) and the need for immigrants to provide a labour force after 1990.

The population growth by natural increase (assuming a net migration of zero) has been plotted for Canada (Figure 1.1. Appendix C) under the three fertility assumptions, beginning in 1976. It is useful to compare these projections with those which include the immigration component. (Figure 1.4 Appendix C)

(iii) Migration Assumption

In the past, international migration has played an important role in the changing demographic structure of Canada. There is little doubt that, barring any severe legislative action to reduce the net rate of immigration, the future population of Canada and its stabilization point will be determined not by natural increase but largely by immigration. For example, for the census year 1973-74, immigration constituted 49% of the total population growth.(4)

In the next 25 years, immigration will have a profound effect on urban settlement patterns, the social and cultural life styles of

Canadians and will play an important role in the development of economic activity.

The analysis of data for the last four decades indicates that emigration from Canada has remained relatively stable, but that immigration has fluctuated widely.(Figure 1.3, Appendix C) For the purposes of this study, the emigration assumptions were based on the trends of the 1960's. (Estimated emigration fluctuated within a range around 60,000 persons a year.) The concept of "net migration" evaluates the difference between immigration and emigration to and from a country in a particular year. A net immigration rate of 100,000 - 200,000 persons per year was assumed in this study, equivalent to admitting approximately 160,000 to 260,000 immigrants annually. This rate corresponds with the Case (B) assumption in the Green Paper on Immigration (5). (In 1974, the immigration total was 218,465 recorded persons, and the emigration figures stood at 42,000 persons.) (6)

Figure 1.3 shows the historical (1952-1974) contribution of net migration to Canada's population growth. It has ranged from a low of about 3% in 1962, to highs in 1953, 1958, and 1967 (averaging about 20% per annum until 1970).

(c) THE CANADIAN POPULATION - OUTLOOK 2000 AND BEYOND

On the basis of the previously outlined assumptions, two sets of population scenarios for Canada into the next century are projected. One option (Table 1.2) projects the total population for Canada under the three alternative fertility rates, a net migration of 0 commencing in 1976 and mortality assumptions outlined in Section 1(b)(i) and Table 1.1.

Table 1.2 CANADIAN POPULATION PROJECTIONS to 2001
ASSUMING 0 NET MIGRATION

Fertility Rate	1976	1986	2001
1.8	22,533,590	24,624,410	27,094,790
2.1	22,671,500	25,317,010	28,841,940
2.6	22,901,360	26,471,340	31,753,860

Under this projection the potential range of total population extends from 27 million for the low case to 31 million for the upper case by 2001. The second option (Table 1.3) tabulates the projected future population in Canada, incorporating an assumed net migration of 100,000 per year.

Table 1.3 CANADIAN POPULATION PROJECTIONS TO 2001
ASSUMING 100,000 NET MIGRATION

Fertility Rate	1976	1986	2001
1.8	23,063,860	26,376,580	30,899,850
2.1	23,204,620	27,104,760	32,780,140
2.6	23,439,210	28,313,380	35,913,960

The extension of the lower fertility rate projection in this table will result in about 31 million people by 2001, while the higher rate will yield almost 36 million people by 2001.

The figures have been plotted graphically (Figure 1.4, Appendix C), and the projections extended to the year 2071, in order to illustrate the divergence inherent in various combinations of these assumptions.

These figures, calculated by Environment Canada are higher than those used by MSUA because of the assumption of longer life expectancy. This assumption becomes more important as one moves towards the year 2000 in terms of the implications for Canada of a larger aging population on the physical, economic and social environments in the future. The nature of population growth thus becomes the key variable in an equation embracing many other factors in future Canadian development.

(d) AGE - SEX STRUCTURE OF THE CANADIAN POPULATION

Another aspect of the demographic picture, besides aggregate growth, in the determination of future trends of the Canadian population is the age-sex structure. The relative size of the various age and sex groups has considerable significance for a population's productivity, standard of living, cost of educational and welfare programs, degree of racial and ethnic integration, impact on urban and rural ecosystems and the achievement of national, social and economic goals in general.

While sex ratios are not at present a significant factor in the demographic picture, there are future possible shifts which may alter this situation. The difference in life expectancy between males and females (Table 1.1) will mean a larger and possibly economically disadvantaged number of older women by the year 2000. Secondly, an immigration policy which supported the "guest worker" concept such as that practised in Germany, Switzerland and France might bring large numbers of male laborers into Canada for specified periods of time, generating significant regional impacts (both economically and socially). Finally, "the biological time-bomb", i.e., the predetermination of the sex of children - cannot be ruled out as a further possibility within the next 25 years; this could affect the sex-ratio substantially.

Of greater immediate significance is the changing age-structure pattern, due to the combined effect of the demographic perturbation known as the "baby boom" and the sharply-lowered fertility rate which followed shortly thereafter.(7) The Statistics Canada study of the age-sex structure of the population from 1851-2001 (Figure 1.5, Appendix C), shows that the long term demographic trend in Canada is distinguished by its lower percentage of children, its high percentage of adults and what will be an unprecedented, high percentage of aged persons.

This means that over the next two decades, Canada's age pyramid will continue to contract at the base, expand at the centre and at the apex (Figure 1.6, Appendix C). The numbers are shown in Table 1.4.

Table 1.4 PERCENTAGE OF CHILDREN, ADULTS AND AGED IN 1971, 1981, AND 2001

	1971	1981	2001
Children (0-14 years)	29.5%	23-24.5%	19.5-22.5%
Adults (15-65 years)	62.5%	66.5-68%	66-69%
Aged (66 years plus)	8.0%	9-9.5%	10-13%

The projections quoted above reflect an entirely new kind of age structure. Canada has never encountered such a small population of children, relative to such a large population of adults and aged persons. The demographic picture shows that the child dependency* ratio will fall from 0.47 to an unprecedented low of 0.29-0.33 by the year 2000, the aged dependency ratio will rise from 0.13 in 1971 to an unprecedented 0.15-0.19. In an urban society which has replaced extended family households with a social welfare system (always subject to inflation), the problem of caring for this future group of aged persons will grow in significance, as seen in Table 1.5, whereas the relative costs of caring for and educating the young will tend to decrease.

Table 1.5 NUMBER OF AGED PERSONS IN 1971, 1981 AND 2001

Year	Number of aged persons
1971	1,744,000
1981	2,201,000
2001	3,103,000

The "aging" of the Canadian population will continue as the "baby boom" cohort moves through the system so that by the year 2000 the proportion of aged people in our society will grow to between 10-13%, compared to 7.5% in 1971. This can be compared with the U.K. in 1970 with 12.8%, and France in 1968 with 13.4%. (8)

(e) REGIONAL DIFFERENCES

The 1971 Census reveals that there are considerable and significant variations in age structure between regions. (Figure 1.7, Appendix C).

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* "Dependency ratios" do not measure actual economic dependence but reflect only future potential economic burden on the labour force.

By region, the Maritimes have the highest proportion of children, the lowest proportion of adults (due to high emigration of workers). The Atlantic provinces have the highest child and total dependency ratios.

Quebec's age structure shows the lowest proportion of aged, the highest proportion of adults, and a 0-14 age group close to the national mean. Quebec therefore has the lowest dependency ratio on all counts. (Aged-to-child and total).

Ontario's age structure assumed an average level for all parameters. However urban/rural differentials, which particularly affect Ontario, show that the proportion of children and aged persons in large urban centres was low, due to the high in-migration of job-seeking adults, while rural child-aged ratio were high in comparison.

The age structure in the Prairie region assumed an average level, but some deviations from the national mean may have significant economic implications for the future. Specifically, the proportion of adults in the Prairies (taken together) is below the national mean while the proportion of children and aged persons is above it. Consequently, the average dependency ratios for the three Prairie provinces were above the national mean.

Finally, British Columbia (as a region) has an average proportion of adults, combined with the lowest proportion of children and the highest proportion of aged persons. While B.C.'s overall dependency ratio was close to the national mean, its aged-to-child ratio was the highest of all the regions, reflecting migration of retired people to the favourable climate of Southwestern B.C.

(f) POSSIBLE IMPLICATIONS OF THE CHANGING DEMOGRAPHIC PICTURE

Important political, economic and social implications can be inferred from this changing demographic picture. If the trends evident in 1971 are projected to 2001, the present political balance both in numbers of people and in age distribution would be seriously eroded. The growth of Ontario, Alberta and British Columbia would further weaken the relative position of the other provinces and heighten regional disparities. This trend is reinforced by the increased population in large cities and the relative decline of many of Canada's regionally - important centers (Montreal, Halifax, Regina).

Economically, there are several conclusions which become apparent. The increased number of aged will mean that the need for medical and social services will more than double by the year 2001. Nearly 24% of our population will be over 55 in 2001. The large working population during the next 10-15 years should be able to adjust to the social and technological priorities of this older age structure.

But as the young become relatively fewer, and those in middle age become relatively more numerous, there are likely to be effects upon production systems, pressures for retraining of older workers, and strong demands for better facilities for the elderly as the middle-aged cohort of 2000 begins to approach its own old age.

The changing age structure of Canadian society will have a profound effect upon the economic and social activities as we now know them. As the percentage of aged persons increases, this change will likely be accompanied by a transition of values, which will reflect to a significant degree the more mature make-up of the population.

Acquisition of material goods usually tapers off after the child-rearing years so that there will be a shift in demand from private goods and services to public goods and services. An increased concern with "quality of life" will emerge. This may lead to new perceptions of environmental quality and/or demand for further recreational facilities. At the same time, the smaller number of young people will seriously affect material flows, consumption patterns and labour force strength. Primary and secondary industry will press for new immigrant labour to make up the shortfall in supply.

Table 1.6, (Appendix B) summarizes some of the possible effects of the changing age structure. What needs to be emphasized is that future population growth in Canada and the distribution factor are central to any discussion of policy options in any other sector of society. Re-inforcing this postulate is the exploration of present trends in urbanization which follows.

2. URBANIZATION

(a) INTRODUCTION

Canadians are a mobile people and this fact, rather than aggregate population growth rates, will have a greater long-term impact on the Canadian demographic picture during the next 25 years. In the post-war period, Canada has experienced a higher rate of urban growth than any other developed country.(1) If this trend towards urban settlement continues, by the year 2001, a possible 90% of Canadians will live in urbanized areas. In terms of numbers, the overall growth (8.2 million) plus the rural-urban shift means that the growth in urban population could be 11.6 million, assuming a total population of approximately 30 million by 2001.(2)

If current trends are projected to 2001, (see 2(c)(i)), the present regional population distribution will be changed, as Ontario, British Columbia and Alberta gain, both from internal and external migration; Quebec, Manitoba and Saskatchewan gain immigrants but lose on interprovincial migration and the Atlantic provinces lose on both counts.(3) This means that by 2001, the provinces of Ontario, Alberta, and British Columbia, would contain 65.6% of Canada's total population (Table 2.2, Appendix B), or almost 2/3 of the total.

A second aspect of urban growth and distribution is the increased influence of immigration on population in the three metropolitan areas of Montreal, Toronto and Vancouver. From 1961 to 1971, Toronto increased by 44% - immigrants accounting for one-half of that growth; Vancouver, 37% with immigrants making up almost one third; and Montreal by 30%, with one quarter of this represented by immigrants.(4) The effect of immigration on future population growth will continue to be significant in these urban areas.

The net result of continuing population growth trends, whether it occurs through natural increase, international or internal migration is that people tend to settle increasingly in fewer areas in Canada. This concentration of people is accompanied by industrial activity which generates higher energy consumption, creates greater demand for complex transportation systems, and stimulates new scientific and technological advances whose spill over effects are not always understood. As well as considering the economic activity of these larger metropolitan centers, questions relating to the resource base of an urban region must be assessed. What implications are there for land use (and hence food production)? What levels of pollution control (affecting land, water or air) and waste management systems need to be put in place? What is an optimum population size, taking into account the overall carrying capacity of a region?

(b) GENERAL ASSUMPTIONS

Projections of future demographic trends following Romaniuc assume that by the year 2000 Canada's population will range between 31-36 million (see Chap. 1, Table 1.3). MSUA, has suggested as a planning target for urbanization in the next 25 years a figure of 30 million based on the following assumptions:

- a fertility rate of 1.8 in 1985
- a net immigration of 100,000 per annum
- internal migration of 450,000 per annum
- mortality rate levelling off after 1985

The procedure in this chapter is to set out two alternative future distribution trends the first assuming a continuation of present unstructured concentration and the second postulating managed urban growth over the next 25 years.

(c) URBANIZATION ALTERNATIVES

(i) Continuation of Present Trends

This postulates that present trends in the rate of urban growth will continue, i.e., those trends evident up to 1971 are projected to 2001. An increase in existing large urban centres and differential rates of growth between regions will result, with Ontario, B.C. and Alberta gaining people more rapidly than Quebec, the Atlantic region, Manitoba and Saskatchewan.

By 2001, the population will concentrate increasingly in large metropolitan areas, particularly Toronto and Vancouver. Eight other smaller cities are expected to increase their population by more than 50%. These are: Victoria, Edmonton, Calgary, Ottawa-Hull, Quebec City, London, Kitchener, and St. Catherines. Relatively slower growth will be found in Regina, Saskatoon, Winnipeg, Montreal, St. John's, Halifax, Moncton, Saint John and Fredericton. Montreal, Toronto and Vancouver will account for approximately one-half of the metropolitan population.

Table 2.1 (Appendix B) shows the various changes in size of cities from 1971-2001. Cities which will exhibit a growth in population of more than 75% between 1971 and 2001 are: Vancouver, Victoria, Calgary, Edmonton and Sudbury; cities which will grow less than 25% are: Regina, Saskatoon, Winnipeg, Montreal, Chicoutimi-Jonquière and St. John's. Saint John and Thunder Bay would show an absolute decline in population. The proportion of total population contained by Ontario, Alberta and B.C. will rise from 53% in 1971 to 66% in 2001. Ontario alone will contain 43% of Canada's population, with most of it concentrated in the Windsor-Niagara-Toronto corridor. The Toronto metropolitan area alone will contain about 12% of Canada's population. This pattern of development would result in large-scale urban expansion in some of Canada's best, food-producing regions, particularly central Canada's finest soft-fruit growing region: the Niagara peninsula.

The distribution of population by province for the continuing trend is shown in Table 2.2 (Appendix B) with the actual figures (in 000's) for 1971 and the expected distribution for 2001. Table 2.3 (Appendix B) shows the proportion of the population in the CMA's by province. It is interesting to note that for Ontario and Quebec, the CMA's will represent a smaller proportion of the population than in 1971. There are two possible reasons for this: 1) the probable growth of non-CMA urban centers (classified at present by Statistics Canada as any center with over 1,000 people) and/or 2) growth at the fringe which may or may not be included, because of confusion about what constitutes a "central metropolitan area".

Two isodemographic maps of Canada (Figure 2.1 and 2.2) show the relative population distributions, (based on the 1966 census data: Perspectives Canada, Statistics Canada, 1974) for 1971 and for the year 2001. These maps clearly depict the disproportionate distribution of population regionally and provincially if present settlement trends continue.

As can be seen on the isodemographic map for the year 2001, greater concentration would mean a "megalopolis" incorporating Windsor, London, St. Catherines, Toronto and Ottawa-Hull, with a relatively smaller Montreal. In terms of absolute size, however, the Quebec-Windsor corridor will contain almost 50% of Canada's population, with the Edmonton-Calgary corridor and Vancouver-Lower Mainland B.C. corridor the other two major conurbations.

Some of the implications of the continuation of present trends in urban settlement growth are:

- increasing loss of prime agricultural land (lower mainland of B.C., Windsor, Niagara, Toronto corridor),

- increasing need for new forms of pollution and waste control to contend with greatly increased population concentrations,

- increasing threats to public health through the generation of harmful byproducts by industries expanding in or near population concentrations,

- increased proportion of older people, more prone to long term pollution-induced or pollution-aggravated illnesses, will further strain health and welfare systems,

- increasing need for additional transportation infrastructure (with its attendant pressure on energy demand, land use, city core, etc.)

- increasing pressure on the whole carrying capacity of heavily urbanized regions,

- air sheds, clean water, land for parks both within and surrounding urban regions,

- the need for development of large numbers of new resource-bases (mostly in "frontier" and ecologically fragile regions) in order to ensure adequate supplies of raw materials, energy, recreational access,

- increase in urban industrial activity, technological advances with both positive and negative effects for urban dwellers.

(ii) Preservation of 1971 Regional Distribution

This second alternative postulates that a redistribution or redirection of population growth away from present large urban centres will take place in order to diminish serious regional imbalances by 2001. Concerted efforts would be made to slow growth in the very large metro areas by shifting growth to the smaller urban centres such as Ottawa-Hull, Windsor, Halifax-Dartmouth.

Management of population settlement patterns, so as to preserve the 1971 regional balance, would require redirection of growth on a scale never before tried in Canada. Some regional planning schemes such as the Edmonton Growth Plan, the Lower Mainland, B.C., and the Toronto-Centred Region have been initiated to deal with local situations. But the question which arises is: Can incentives be devised at the national level which will encourage population redistribution?

The basic assumption of this alternative is that policies can be developed and implemented, which will channel growth so that the 1971 provincial distribution pattern would be preserved. Incentives to slow the growth of Toronto, Montreal and Vancouver would be complemented by expansion in other urban centers. To accomplish this would require that:

1. The 22 CMA's would, by the year 2001, represent roughly the same proportion of the total national population (56-58%), as the 1971 distribution.

2. The 3 major urban concentrations (Table 2.1) would represent a smaller proportion of the total population of the 22 CMA's in 2001, than in 1971.

3. Growth rates of the CMA's would be adjusted so as to (a) increase population growth in "slower-growth" provinces, (b) keep the population of the CMA's at a "reasonable" proportion of each province's population, and (c) slow growth in the 3 major CMA's relative to the 19 others.

A plausible set of growth rates to fulfill these assumptions is as follows: (other rates are possible, consistent with the assumptions).

1. 0.5% growth per year: Vancouver, Toronto.

2. 1.0% growth per year: Victoria, Calgary, Edmonton, Hamilton, Kitchener, London, Ottawa-Hull, St. Catharines, Sudbury, Thunder Bay, Windsor, Montreal.

3. 2.5% growth per year: (CMA's in provinces other than B.C., Alberta and Ontario); Saskatoon, Regina, Winnipeg, Chicoutimi-Jonquière, Quebec, Halifax-Darthmouth, Saint John, St. John's.

In this alternative, other smaller centres would grow more rapidly in future, so that one could also expect the 22 CMA's to represent a smaller proportion of the total national population.

The proportion of population in the provinces for this alternative is shown in Table 2.2 (Appendix B) Table 2.3 shows the proportion of each province's population represented by the CMA's within its borders.

Redistribution of population will have various implications:

- Transportation/communication networks will become a major component of designing high population growth in present slower-growth areas.

- Industrial production along with transportation networks, cultural and recreational facilities will have to be encouraged in provinces other than B.C., Alberta and Ontario.

- Many provinces will be faced with larger-scale environmental responses; i.e., cities such as Halifax-Dartmouth, Chicoutimi-Jonquière, St. Johns, Winnipeg, Saskatoon would more than double in size under this alternative.

- Population growth in centres of high urban density will require greater planning initiatives in pollution control and waste management.

- Population growth in centres of lower urban density increase total consumption of land, much of it high-class farmland, demand more energy-intensive transportation systems, and tax the financial viability of urban centres.

(d) THE URBAN FRINGE

(i) Development of the Urban Fringe

Urbanization is a dynamic activity which takes place on a broad and complex front. As population grows and changes are accommodated in "older" parts of the city, the area considered "urbanized" grows by accretion at the edges.

Since 1960, the urban fringe has come to be seen as an area of complex activity, where many of the problems of growth appear. The implications of this trend are not yet clearly understood. There has been a rapid growth of a rural, non-farm population, consisting of retired persons, commuters, families owning second homes and young people experimenting individually and collectively with subsistence farming. For example, from 1966-71, in the hinterland outside Toronto, farm population in eight selected countries declined by 17,400 persons, while rural, non-farm population rose by 40,300. (5) Similarly, this new pattern of urban growth shows considerable differences in the age structure of its population - a higher proportion of children in rural, non-farm areas than in the cities, but a lower proportion of people between 20-34 in rural areas, attributed to the out-migration from farms of both males and females.(6)

Canada had an estimated 108 million acres of improved farm-land in 1971. (Statistics Canada). Land use trends from 1966-1971, were as follows: (Figure 2.5)

Urban land area - increased by 10.6%
Urban-oriented land area - increased by 13.5%
Infrastructure land area - increased by 0.8%
Recreational, conservation land area - increased by 59.8%
Forestry land area - decreased by 1.1%
Agricultural land area - decreased by 1.6% (7)

Overall, the area of improved farmland has increased during this century. (See Figure 2.6; Appendix C from Chart 9.12 Perspectives Canada) However, since 1966 growth in improved acreage has stabilized at about 108 million acres. In terms of distribution, improved farm-land has decreased since 1941 in eastern Canada, and increased in western Canada, as shown in Table 2.4.

Table 2.4: PERCENTAGE CHANGES (OVER PREVIOUS CENSUS) IN IMPROVED AGRICULTURAL LAND

Acreage by Region in Canada

	Maritimes	Quebec	Ontario	Prairies	B.C.	Canada
1941	-16.9	-2.6	-5.0	9.6	28.6	5.7
1951						
1961	-21.7	-10.9	-5.2	11.9	13.5	6.8
1966	-6.5	-2.6	-0.2	6.0	23.9	4.6
1971	-19.3	-15.5	-9.5	2.9	8.7	0.0

Source: Statistics Canada, Census of Agriculture, Ottawa

Transfer of farmland has been approximately 70% to urban uses and the rest to woodlot and forestry.(8) Conversion of farmland to woodlot usually occurs at the urban fringe, and an appreciable proportion has apparently been related to recreation. For example, farming activity in terms of number of acres of farms, and farming population decreased from 1941 to 1971 in the Windsor-Quebec axis, while urban and rural non-farm population increased significantly. (Figure 2.6, Appendix C) (9)

Urbanization usually occurs with finger-like, or "strip" development, often along a highway, interspersed with parcels of denser development. Emphasis is on single-family dwellings, giving low densities, and high unit infrastructure costs. A decrease in farmland and open space occurs as improved land (with more intensive and complex cultivation patterns) increases in value and changes market demand. Once land is urbanized, it is not economically feasible to reclaim it for agricultural use. In a world of rising food prices, protection of good farmland would be aided by the encouragement of urban growth into areas of less valuable land.

On an aggregate scale, it has been estimated that about 168,000 acres (260 square miles) of land were consumed for urban developments between 1966 and 1971, or about 34,000 acres (52 square miles) per year. Of this total, cities with over 100,000 population consumed most. (10)

Estimates of land consumption per unit increase in urban population have varied from 0.38 to 0.79 acres per capita. Based on the expected urban population increase of about 12 million, 7,150 to 14,800 square miles of land would be taken up by urbanization in the next 25 years.(11)

Over 50% of the urban expansion occurred in the best agriculture land (Class I and II). As an example, Southwestern Ontario's farmland, the best in Canada, is about 57% Class I and II. All of the rapidly growing urban centres - Windsor, Sarnia, London, Kitchener-Waterloo, Hamilton and Toronto are encroaching on this prime agricultural land.

In terms of relative intensity of land consumption, the larger the centre, the less land per capita was consumed, i.e., a population increase in a centre of 1000 people used 40% more land per capita than a centre of 10,000.(12) In other words, densities of urban areas increased as population increased. (Such densities are shown in Figure 2.3, Appendix C, derived from Perspective Canada, Chart 9.10).

The histrocial growth of urban areas has therefore assumed a pattern of ever-increasing expansion at the fringe, a pattern which has produced increasing strain on land use, transportation systems, recreational areas, and ecological systems. Whether this pattern can be allowed to continue in future becomes a central issue for long term settlement planning in Canada.

(ii) Municipal Revenues

An additional element for urban and municipal planning is the problems of tax resources and expenditures. The expansion of urban area and urban fringe has been accompanied by pressures on tax resources. Urban cores have increasingly been converted from residential to commercial use, and the fringe areas have been the focus of low-density and (often uncontrolled) miscellaneous industrial and urban development. The federal and provincial governments control the major sources of tax revenue (income and various sales taxes), but municipalities have to deal with local planning and environmental concerns. (In the fringe areas, in terms of taxes, population densities of 0.3 to 3.5 people/acre have consistently paid less in municipal taxes than they have received in services.)

Rapidly rising expenditures have placed most urban areas in an increasingly precarious financial position, so that future developments to ensure environmentally acceptable and "reasonably liveable" conditions may be placed in jeopardy in 10-15 years because of urban financial problems alone.

The tax resource picture is outlined Table 2.5 below: (Financial Times of Canada, June 23, 1975)

Table 2.5: TAX SOURCES AND MUNICIPAL REVENUE

A. Indirect Tax Sources (as Percent of Total Personal Income)

	1964	1969	1974
Federal	7.6	6.5	7.7
Provincial	5.4	6.4	6.5
Local	5.4	5.6	4.3
Total	18.5	18.5	18.5

B. Sources of Municipal Revenue (Percent)

	1964	1969	1974
Local account	84.6	76.7	54.0
Senior government grants & transfers	15.4	23.3	46.0

Trends indicate that local governments have been receiving a decreasing proportion of indirect taxes, (down from 5.4% in 1964 to 4.3% in 1974), with an increasing proportion of their expenditures covered by grants and transfers from higher levels of government. Expenditures of local governments have been rising more rapidly than their income and income sources: every major city in Canada has experienced deficits over the last 3 years. In 1964, the federal government had a surplus on a national accounts basis of $345 million. The provinces had a deficit of $81 million, and local governments a deficit of $141 million. Ten years later, the federal government had a surplus of $685 million, the provinces a surplus of $449 million, and local governments a deficit of $1,351 million. (Financial Times of Canada, June 25, 1975: "Can the Cities Avoid Bankrupcy?")

In order that an accurate assessment can be obtained as to the exact nature of the situation, a "Tri-Level Task Force on Municipal Finance" has been set up; it will produce an interim report in December, 1975 which will assess whether or not a real problem exists, and what is the nature of the problem. The present trends indicate that existing sources of revenue may not be sufficient for local governments to retain reasonable services, and that rapidly rising transfer payments are eroding local autonomy. The exact nature of possible future problems remains to be assessed.

(iii) Implications of the Development of Urban Fringe

The expansion of the urban fringe has a wide variety of implications. The most significant is that expansion has resulted in loss of agricultural lands (see above) of varying quality, but a loss nonetheless. In addition, loss of farming land to direct urban use has also been accompanied by a transition of farm land to woodlot and infrastructure use, plus a loss of woodlot lands, which form sanctuaries for birds who prey on insects. Increasing urbanization has also generated an increased demand for recreational land outside the city which woodlot preservation might help to alleviate. This demand has been reduced somewhat, but not significantly, by urban recreational facilities such as parks, community centers, bicycle paths, etc.

To minimize the loss of good agricultural land in future urban growth, increased concentration could take place in the larger urban centres. For example, a city of 400,000 can be accommodated in 150 square miles if developed to a density similar to that of Montreal (present population 2.7 million). But a density similar to that of Ottawa-Hull (present population 0.6 million) would require 560 square miles.

Increasing the efficiency of urban land might be accomplished by the development of unused land and parking lots, minimizing the conversion of streets to 4 to 6 lane through-fares, standard 5-6 story heights for buildings. Alternatively, the population densities of existing low density urban areas, such as Ottawa-Hull, Winnipeg, Hamilton, Edmonton and Calgary, could be increased. This would mean controlling the expansion of the urban fringe areas, increasing the population density of established growth areas and protecting agricultural land from urban sprawl.

Increased population densities will increase adverse environmental effects downstream. Better pollution control in order to ensure adequate environmental quality plus more extensive monitoring will be required. Provided the financial (tax) resources are there, and provided that adequate urban planning takes place to ensure a reasonable urban environment, greater concentration of population could have several advantages by:

- reducing the loss of agricultural land,

- creating the conditions for economies of scale in pollution and waste control and making recycling a more viable alternative,

- lessening the demand in the areas of recycling, use of waste heat, more efficient heating of higher-density dwellings, etc.

- urban recreational infrastructures which place less demand on leisure time transportation (i.e. National Capital Commissions "green-belt" activities, more urban parks at ground level or using the roofs of buildings for gardens.)

(e) RECREATION AND TOURISM

Recreation is becoming an increasingly important aspect of Canadian economic and social life with rising impact on the physical environment. Several factors contribute to this relatively new (20 years) "growth" industry. First, there is an increase in the amount of leisure time available to people, due to such things as shorter work weeks, earlier retirements and longer life expectancy. Secondly, the expansion of the transportation sector of our economy has stimulated tourism and made possible an ever wider range of choices in recreational activities. A third factor is the shift in values of the Canadian population, i.e., emphasis on physical fitness, decline of the "work ethic", dissatisfaction with city life, etc. As population continues to grow and more and more Canadians become urbanized, the demands for and the strains on, recreational areas are bound to increase.

Table 2.6 shows that, on the average, by the mid '80's, people will spend a larger proportion of their lives out of the work force. (14) In 1976, 1.9 hours of "discretionary" time is estimated for each hour worked throughout the year. By 2000, that figure will rise to 3.8 hours of "discretionary" time for each hour worked, excluding time for sleeping, eating and personal maintenance. In 1976, 65% of the "available" time was discretionary; by 2000, it is expected to be 79%, or almost four fifths.

The projections, however, have to be considered in the light of a potential labour shortage in the early and mid-1980's (encouraging longer work periods), and the attitudes toward work itself. Some forms of work may become "valued" so that the trend to more "discretionary" time may level off at a lower rate.

Economic factors are also relevant to the growth of leisure time.(15) For example, consumer expenditures, representing about 2/3 of all spending in Canada, has grown at about 7% per year for the last decade. "Discretionary" spending represents about 1/3 of this amount and has grown at about 9% annually at the same time. Hence "discretionary" spending is expected to be an increasing proportion of consumer spending if present trends continue, more than doubling by 1986.

The "service" sector of the Canadian economy which includes recreation employed 62% of the civilian labour force in 1972; the manufacturing sector only about 22%. Over the next decade, the service sector will probably rise to 70-72% of the total labour force. Employment in the "recreation" sector, however, is expected to grow 90% in the next ten years, compared with an expected growth in employment in the whole service sector of 55%. (See Figure 2.8, Appendix C).

In 1969, Canadian families spent an average of 18% of their total current consumption on items related to travel, tourism and outdoor recreation. Spending on all recreational goods and services was $567.8 million in 1951, $951.7 million in 1961, and $2,114.7 million in 1971. (Perspectives Canada, 1974, Table 5.16).

Tourism alone is an important activity in Canada. By 1970, tourism represented the third largest industry in Canada in terms of gross sales.

Manufacturing	$53.4 billion
Construction	9.3 "
Tourism	6.6 "
Mining	5.7
Communications/utilities	5.5
Agriculture, fisheries, forestry	1.1

Tourism receipts also ranked second in 1967, 1970, 1971 and 1972. (Trends in export receipts are shown in Figure 2.9, Appendix C) Of Canada's total labour force, 8.1% were employed in services directly related to tourism in 1971. All travel in Canada generated direct and indirect business valued at about $7-9 billion in 1971, or about 7.5-9.6% of Canada's GNP.

At present, tourism represents about 10% of the gross provincial product of Ontario and employs about 10% of its work force. In Quebec, in a few years, tourism will surpass pulp and paper to become its most important industry. In the Maritimes and B.C., it is one of the fastest growing industries. Present government spending on recreation and leisure activities has been estimated to be about $1.5 billion. Of this, federal expenditures represent about ½ to 2/3 of the total. (Office of Tourism, IT&C, personal communication)

An important recreational supply issue for the future is that of the availability of land and water. As Canada has become increasingly urbanized, the demand for recreational land and water facilities has grown. U.S. estimates (1959) indicate that between 1950 and 2000, recreation use of city and country parks in densely populated communities will quadruple; intermediate recreation in state parks and reservoir areas would increase 16 times; and resource-based recreation in areas where natural qualities are important would increase 40 times. The need for wilderness and open space in and around urban areas in Canada is estimated to be:

by 1980: minimum of 67,000 acres
by 2000: minimum of 300,000 - 400,000 acres

In terms of population, parkland, both national and provincial across Canada is very unevenly distributed. (See Table 2.7, Appendix C). The Atlantic Provinces are relatively under-represented in terms of parkland: they contain 9.5% of Canada's population, but only 1.2% of the park area. Quebec, with about 28% of the population, contains over 50% of the park area, while Ontario, with 36% of the population, contains only 4.5% of the park area. Manitoba, Saskatchewan and B.C. are reasonably provided with parkland; Alberta is somewhat over-represented.

The implications of this distribution is that the Maritimes which could build up their tourist industry further to assist their economic growth, may find the lack of parkland an impediment. Similarly, Ontario, with its large population and heavy industrialization is inadequately supplied with recreational park land, especially near urban areas. In addition, the three major accessible provincial parks in Ontario (Lake Superior, Quetico, Algonquin) have about 4/5 of their combined area accessible to timber operations, further restricting their use. The result in Ontario, is congestion, not only in the parks, but on the highways, as urban dwellers seek wilderness recreation areas.(14)

However, the large amount of energy consumed in transporting people to parks (primarily by private automobile) may favour future development of recreational areas and parks in or closer to urban areas. Acquisition of woodlots, marginal lands, and abandoned farms, such as the recreational complex at Milton, could augment the needs of urban dwellers for open space. Energy conservation will require that future parkland be planned in conjunction with public transportation networks, and that more effort is put into planning urban park space for city dwellers.

Use of available parkland has increased greatly over the last few decades. The number of visitors to national and provincial parks has been estimated as follows:

1951	about	4.5	million	visitors	per year
1961	"	6.5	"	"	"
1966	"	35	"	"	"
1971	"	55	"	"	"

For 1976, the estimate is about 60-70 million visitors, and by 1986, possibly 90-100 million, assuming that trends over the last decade continue. This projected increase in demand for recreation space, plus the economic importance of tourism, put added strain on environmental support systems. (forests, water, wildlife) Conflict between industrial activity, recreational use, conservationists and social well-being of urban dwellers is likely to increase in the next 25 years.

(f) TRANSPORTATION

It could be argued that all future urban growth is a function of transportation development policies. The connecting links between settlements have come to be seen as an integral part of the way cities grow. (Jane Jacobs; C.A. Doxiades) No one, it seems, predicted the phenomenal growth of North Toronto which would result from the building of the Subway.

The transportation section discusses the general problems of urban, intercity and national passenger and freight transportation, without treating the distributional or regional aspects of the various modes. Since developments in the transportation sector to 2000 will be affected by the transportation policy presently being considered by Cabinet, major changes may possibly be seen in the near future.

(i) Urban Transportation

Transportation in urban areas in 1970 has been estimated at 47.04 billion passenger miles for automobiles or 91% as opposed to 9% for public transit. (Table 2.8, Appendix B) Between 1961 and 1972, car registrations increased from 4.3 million to 7.4 million or close to 6.5% per year. (Figure 2.10, Appendix C) Car ownership, then, has far outpaced the natural population increases. As energy and materials costs increase, the trend will be to more efficient and smaller cars. (The Chairman of American Motors feels that by 1980, four out of every five cars sold in the U.S. will be small ones. Presumably there will be a similar shift in Canada). The Transportation Development Agency forecasts that if present conditions persist, the automobile will still be the dominant form of transport in Canadian urban centres in the year 2000 despite the fact that mass transit uses less than half the energy per passenger-mile. (Table 2.9, Appendix B) This would mean that by 2000, the automobile would still represent 92% of all urban passenger-miles. The total number of passenger-miles travelled would increase by 300% from 51.7 billion in 1970 to 155.3 billion in 2000. (16)

However, these projections may not sufficiently reflect the effects of rising fuel costs. With federal and provincial assistance, mass transit could become an increasingly important future alternative to the automobile. In addition, if there is a deliberate increase of population densities in urban areas to control land use and loss of agricultural land, mass transit becomes technically and economically more feasible. It has been estimated (Cappon, 1974) that a city of 400-500 thousand is large enough to demand a completely updated rapid mass transit system. Canada already has several cities of that size - eg. Winnipeg, Ottawa, Vancouver. (17)

High-speed transit in most Canadian urban centres will require a flexible approach tailored to each city's needs. Factors such as urban geography, the political scene, local land use problems, user requirements and population size and density will have to be considered.

The cost of urban traffic congestion has been estimated by Tanner (1965):

at 15 mph - 10¢ pm per vehicle
at 10 mph - 25¢ pm per vehicle (18)

Traffic congestion itself tends to precipitate actions which aggravate problems, especially in city cores. Pressures increase to build more roads and freeways, and to improve existing ones, to facilitate traffic flows. This results in increased air and noise pollution, the loss of valuable city land, and often the splitting of residential communities. Ottawa Pollution Probe has estimated that provision for cars - streets, parking and service facilities - takes up one-half of the entire downtown area. In addition, there are approximately 16,000 parking spaces in downtown Ottawa, occupying land worth $40 million. (19) Automobile congestion in city cores tends to force people, particularly families, to move out to the suburbs, aggravating urban sprawl, increasing downtown traffic, raising pollution levels and driving up energy consumption.

(ii) Intercity Passenger Transportation

Intercity passenger travel is also dominated by the private automobile: in 1970 it represented 85% of the passenger-miles, followed by air (7%), bus (5%), and rail (3%) (See Table 2.8, Appendix B). Projections by the Transportation Development Agency indicate that the automobile will represent 84% of the intercity traffic in 1980, 74% in 1990, and 62% in 2000. However, TDA forecasts continued increases in air travel (from 7% in 1970 to 33% in 2000) with the other modes remaining essentially constant. The total number of passenger-miles travelled will increase absolutely from 77.6 billion in 1970 to 232 billion by 2000.

The long term effect of increases in fuel prices cannot be predicted. The lessening of the rate of increase in demand brought about by higher fuel prices, may be partially offset by changing technology which lead to increased efficiency and lower fuel consumption. Estimates by the Transportation Development Agency indicate that for intercity passenger movements in the years 1970-2000, a 1% increase in price would lead to 0.8% decrease in automobile travel, a 1.7-1.9% decrease in air travel, and a 2.5% decrease in bus travel, with rail travel not affected *ceteris paribus* (20) Automobile traffic appears to be least responsive to changes in price and bus travel the most responsive.

A doubling in fuel prices between 1970-1990 would lead to a proportional reduction of 11.9% in auto travel, 31.1% in air travel, 13.5% reduction in bus travel with rail travel unchanged. There reductions presumably do not reflect the fact that where there is a decrease in the price of one mode, there will be an increase in the use of another mode. In other words, other things being equal, an increase in the price of rail travel would lead more people to use the bus.

The social costs of automobile transportation borne by the public are somewhat diluted in the context of intercity travel. Less congestion occurs, pollutants are dispersed, and noise presents fewer problems. However, land (see Urban Fringe), especially when it is productive farmland that is taken out of service, remains a serious concern, particularly in the Windsor-Quebec corridor, and the Lower Mainland area of B.C.

In the past, speed and convenience have been the principal criteria in the decision to use air travel over other modes in medium to long distance travel. In future, however, higher operating costs and fuel prices may curb the growth in air travel. Although still in the experimental stage, STOL has the potential to become a viable competitor in certain short distance intercity markets. However, stiff competition could occur from the introduction of the new light, rapid, and comfortable (LRC) train, since estimates indicate that the total travel time of LRC's trains between major urban centres would be competitive with air travel up to medium distances (300-500 miles).

Any increase in air travel would necessitate expansion of present facilities, or the construction of new ones. This will consume land: Pickering will take out of service over 25,000 acres of Class I agricultural land. Aircraft emissions affect air quality; however, expected technological developments would lessen this impact. Noise pollution is slowly being controlled; present wide-bodied large jets produce less noise than earlier standard models, despite the fact that they are 2 to 3 times as heavy.

Bus travel is one of the most economical modes of intercity travel. Although it uses the highway networks in competition with the car, its load factor is greater, resulting in both a much lower energy consumption per passenger-mile and a lower operational cost per passenger mile. A shift to gas turbines may be made in the near future, since they provide more power with less pollution and lower noise at cruising speeds, but with a penalty of higher first cost and increased fuel consumption.

Competition from other intercity modes of transport have eroded the demand for passenger train service in the past two decades. The services offered by the railways have changed over the years as well, so that today three-quarters of the revenue passenger miles are received from commuters, whose journeys average 12 miles. (Statistics Canada)

Discussions of rail passenger services must go beyond extrapolations of the intercity passenger market to considerations of public policy. Rail passenger services have been highly uneconomical on a direct cost basis, to the point that they have been running as deficit operations, and have only continued in the past with government subsidization. It should be noted that the rail industry has had to pay for operations of its rail terminals and rail-beds, while motor and air transport have had major infrastructures paid for from tax revenues i.e., roads, air terminals, etc. The relative economics between the different transport modes are therefore not strictly comparable, unless such hidden costs are taken into account.

(iii) Freight Transportation

Not only does urban and intercity transportation influence the shape and growth of cities, but national networks also impact significantly on the development patterns of the Canadian economy. The various modes of transporting freight are covered here with the energy aspects of transportation as a whole discussed in the Chapter on "Energy".

In 1970, approximately 350 billion freight-ton-miles of goods were transported inside Canada. Rail and water carriers have watched their share of the market (97% in 1938) erode over the years so that in 1970 they accounted for only 59% of the market. The other 41% was shared between road (16%), oil pipeline (16%), and gas pipeline (9%). The transport of freight by air tends to be very costly and hence it is used only where speed is the main criterion (Tables 2.10 and 2.11, Appendix B).

If Canada continues to grow as a major supplier of bulk, raw resources from the primary manufacturing sector, the demand for transportation services to move these goods will parallel this increase. Past data has shown an increase in freight ton-miles from 62 billion in 1940, 91 billion in 1950, 140 billion in 1960, and 350 billion in 1970. Projections place the total for 2000 at about 1,500 billion ton-miles.

Rail and water would account for 49% of the market, while the other 51% would be shared by road (18%), oil pipeline (20%) and gas pipeline (13%). (Table 2.12, Appendix B) This 450% increase in volume would necessitate plant and equipment expenditures between 1976-1990 of between $26 and $36 billion. ("An Interim Report on Freight Transportation in Canada," Transport Canada, June 1975). A strong federal policy option to aid the growth and development of smaller cities in Canada exists in the control and manipulation of freight rates. Economic activity in cities remote from Central Canada require various forms of support if urban settlement patterns are to be more evenly distributed.

The major commodities carried as freight are shown on the following page:

Table 2.13:

MAJOR COMMODITIES CARRIED AS FREIGHT: 1972/73 AND 1990 (Percent)

Commodity	1972/73		1990	
	Percent	Rank	Percent	Rank
Oil	32.5	1	18.5	2
Iron Ore	19.0	2	34.0	1
Grain	12.3	3	9.2	5
Paper, board, pulp	11.8	4	11.2	4
Coal	7.8	5	11.8	3
Lumber	7.7	6	5.3	6
Steel	5.1	7	4.7	7
Sulphur	2.1	8	2.7	9
Potash	1.6	9	2.8	8

Source: An Interim Report on Freight Transportation in Canada: Transport Canada, June, 1975.

The situation and development of the various modes of freight transportation are as follows:

(1) Total sea-borne trade

- projected to grow 4.5% annually to 1995
- loadings of major deep-sea bulk commodities forecast to increase 9% per annum (Hedlin Menzies and Associates, 1970)

(2) Pipeline transportation of oil and gas

- 8,800 miles of oil trunk lines operated in 1969; this has stabilized and will not increase with possible exception of an eastern Canada line and/or other major oil finds.
- 18,000 miles of gas transmission lines operated in 1969; increased to 22,900 by 1972
- Further major increases expected for Arctic gas transmission.
- In 1972, another 44,000 miles of line existed for gathering and distributing natural gas); (Statistics Canada)
- little land is lost for pipeline transport, except, at pumping stations, but Northern pipeline development will present complex and continuing environmental problems
- slurry pipelines may increase in use for specialized applications (e.g. sulphur in oil, by Shell).

(3) Trucking

- intercity trucking is expected to increase its market share from 10.5% in 1970 to 14.9% of the total freight transport by 2000.

- The trucking industry is predominantly characterized by the movement of packaged goods, particularly adapted to the manufacturing industry. Since this industry is market rather than resource-oriented, short-haul rather than long-haul movements have become characteristic of its transportation requirements.

- The influence of trucking on the environment consists of emissions, energy costs and noise, less onerous on the highways but with severe impacts in urban centres.

(4) Railways

- Total freight-ton miles transported by railways has grown from 55 billion in 1950 to 110 billion in 1970.

- the railway's portion of the frieght transport market has decreased from 61% in 1950 to around 30% in 1970. (Table 2.12, Appendix B)

- while traffic in bulk commodities accounts for about 60% of the load on the nation's rail system as a whole, between Calgary and Vancouver the figure currently is nearer 80-85%.

- Commodity shipments of iron from West Coast ports are projected to double by about 1980.

- By 1990, total exports of iron ore to the three major markets of Japan, the U.S., and Europe are expected to be about 140 million tons per annum. Of this, over 100 million tons will be shipped from the Quebec North Shore in ocean-going bulk vessels.

- It is estimated that investments of up to $200-million in port facilities and $1.2 billion in rail facilities will be required in this area long before the year 2000. (EMR Report MRP 75-7)

- The movement of freight by rail produces energy savings over pipeline or water transport. However, compared to truck transport the savings are much greater both from an energy and a dollar viewpoint. As rail transport becomes more specialized and unit trains evolve, costs will no doubt decrease.

Finally, since these transportation modes often impose themselves on urban centres (e.g. harbour facilities, rail and air terminals, refining and storage depots) they often withdraw large areas from development and other urban uses. Economic reasons have dictated the situation of transportation modes within the urban region, but the spillovers can cause blight of water-fronts, splitting of communities to provide access to downtown cores, and other social costs.

(g) URBANIZATION AND WASTES

(i) Introduction

Projections of future urban growth and population distribution seem likely to intensify the conflict between the need for economic development to accommodate a growing population and the costs to society of dealing with waste products. A major component of increased economic growth (aside from the service sector) will stem from industries whose so-called "residuals" are discharged into the physical environment, often with costly and deleterious effects on human health and well-being.

Non-renewable resource extraction has been a strong component of economic growth; projections of future growth foresee the continuing importance of mineral extraction (see Chapter 3). Because urban growth encourages and is stimulated by industrial activity, the question of properly controlling waste discharges is rapidly increasing in importance. In fact, a recent Delphi panel conducted by the U.S. National Science Foundation (1974) agreed by 92% that waste management was a top priority for scientific R&D in the future.(21)

The sources of waste in 1972 were (see Table 2.14, Appendix B)
mineral extraction.....65.4%
agriculture.....30.5%
industry and municipalities..... 4.1%

In terms of aggregate amounts, the mineral sector produces almost 2/3 of the total amount of waste, agriculture just less than a third, while industries (mostly centered around urban areas) and municipalities produce only about 1/25 of the total amount, in terms of tonnage.

Mineral wastes, with the exception of the aggregate sector which has its sources close to urban centers, tend to be generated in more sparsely settled areas. If mining were to continue to grow at 5% per year, mineral wastes could increase from 440,000,000 tons to 1,760,000,000 tons a year by the year 2000 (22). Mineral processing wastes generated close to urban areas i.e., Sudbury, Hamilton, Sydney, can have a much greater local impact. Agricultural wastes also often tend to be generated close to urban areas in the form of feedlots for livestock, dairy and egg producers, as well as food processing.

Industrial wastes tend to be generated within or close to centres of population. Such wastes are also amenable to recovery and recycling. Table 2.15 (Appendix B) indicates the approximate proportion of recoverable resources being recycled at the present time in the U.S. from industrial processes. In the future, it can be expected that food wastes will also be treated to produce other usable by-products, e.g., whey protein concentrate from cheese whey, distillers' and brewers' waste for cattle feed, etc.

(ii) Land and Wastes

Municipal refuse, while proportionately smaller in quantity than other sources of waste, directly affects communities and/or individuals. With growing affluence, the volume of waste is increasing steadily: counting all categories of municipal refuse, each Canadian generates approximately 1 ton of garbage per capita per year at present, and this figure is expected to rise in the future.* This will result in increasing costs for handling such refuse: assuming present waste handling methods, an increasing amoung of waste per capital, and an increasing percentage treated, total operating costs for land fill or incineration will rise from about $245 million in 1971, to $345-$369 million in 1981, and $624-$764 million in 2001. (Table 2.16, Appendix B). This represents a tripling of costs in 30 years.

An additional factor is the question of land, and land use, in waste disposal. Many urban regions are finding it difficult to secure accessible and acceptable land fill sites either within or outside their provincial boundaries. Buried wastes may contaminate water through run-off into surface water of seepage into ground water. Incineration of wastes can generate air pollution which may spill over into other areas. However, technology is available to process municipal refuse in ways that could be advantageous. Municipal and commercial refuse can be used for the generation of energy, while reducing the volume of refuse (See Table 2.17, Appendix B, for potentiality of using municipal refuse for energy creation)

(iii) Water and Wastes

Per capita use of water in urban areas has been increasing at the rate of 2% a year during this century. (23) At present, the average daily intake is 125 gallons a day per urban resident. This could rise to 200 gallons a day by 1980 and 300-350 gallons a day by 2000, assuming a continuation of present trends. However, it is possible that technological developments, restrictions, recycling, etc., could reduce the rate of growth of water use per capita in the future.

Water use across Canada as follows in 1972: (Canada Water Year Book, 1975)

Table 2.18

WATER USE IN CANADA, 1972 (millions of gallons per day)

User	Withdrawal (mgd)	% of total
Municipal and rural	2,085	9.7
Manufacturing	6,944	32.3
Mineral industry	575	2.7
Agriculture	1,528	7.1
Thermoelectric	10,393	48.2
Total	21,525	100.0

* Note: Average municipal refuse consists of: paper 53%, kitchen waste 24%, metal 5%, glass 6%, other 12%.

In manufacturing, the gross water demand was 16,506 mgd, but the actual withdrawal was only 6,944 mgd, with recycling making up the difference. For manufacturing, (most is carried out around urban areas), Ontario represented 41% of the total of 6,944 mgd, Quebec 26%, British Columbia 15%, and the other provinces the remaining 18%. In terms of industries, pulp and paper consumed 35%, smelting and refining 18% iron and steel 15%, and the other industries the remaining 32%.

At the present time, only 66% of the urban population (i.e., 16.4 million) is served by some form of sewage treatment. Over 90% of untreated municipal sewage originates in urban centres with populations greater than 50,000. Of the municipal sewage receiving treatment, 25% receives primary treatment only. Ten of our twenty largest metropolitan areas treat all of their sewage, three have no treatment whatsoever (Halifax, St. John's, Newfoundland, and Quebec), and the largest city in Canada (Montreal) at present treats only 10% of its sewage. Combined sewers serve a total of just over 6.7 million persons in Canada, representing about 53% of the urban population, and 37% of the total population. (24)

During spring run-off or following heavy rains, sewer systems often overflow, delivering large quantities of raw sewage into receiving water bodies. In addition, surface run-off washes garden pesticides, lawn fertilizers, street salt and sediment directly into urban water courses without any treatment. Except where liquid waste is expelled into the ocean, i.e., Vancouver, most urban regions depend on fresh water systems for waste disposal.

Of grave concern is the increasing number of chemicals, harmful to human health, which are dumped into water courses. Better detection systems have brought home the hazards of lead, mercury and asbestos but the long term effects on human health of many other contaminants are not well understood. A projected shortage in future of clean water is compounded by unanswered questions relating to environmental health and a continuation of viable eco-systems in urban regions. Current Capital and Operating costs for municipal waste water treatment are given in Table 2.19.

(iv) Air

The continued use of the atmosphere as a repository for the waste residuals of combustion and other processes can become incompatible with its primary use - to support life.

As population increases in the 20 largest urban centres in the next 25 years, many more Canadians will be affected. The threat to physical health and wellbeing has to be seen in the context of an aging population since the effects on heart and lungs, particularly of older persons, can be cumulative and delayed. High rates of air pollution will tend to increase health and welfare costs in future as the urbanization and aging processes continue.

Table 2.20 shows projections of emissions from combustion processes to 1990. Carbon dioxide at 94% is by far the largest by-product of combustion and its annual production would triple by the year 2000. Although carbon dioxide is a stable gas necessary to life, some scientists express concern about its increasing concentration in the earth's atmosphere.

While particulate matter could grow eightfold in the next 20 years, technology now exists to greatly reduce, if not essentially eliminate, particulate emission from furnace stacks. (26)

More significant are the second category of pollutants which are chemically active, harder to detect, more intractable and dangerous to human health. Representing 6% of total emissions, they are: carbon monoxide, 55.4%; sulphur oxides, 23.1%, hydrocarbons, 9.8%, nitrous oxides 4.4%.

The source of these emissions as estimated in 1970 were:

transportation.....56.9%
industrial processes.....24.5%
full combustion in stationary sources
(ie generating plants)..... 8.3%
solid waste disposal..... 2.7%
miscellaneous..... 7.6%

After 1970, control devices on automobiles sharply reduced emissions of carbon monoxide, nitrogen dioxide and hydrocarbons. In addition, emission controls in industrial processes have lowered air pollution levels in urban areas, as shown in Table 2.20, (Appendix B). Further controls, technological advances and probable changes in urban transportation could lower concentrations further, despite projected increases in urban populations.

Estimates by the Department of Energy, Mines and Resources (An Energy Policy for Canada, EMR, 1973), indicate that the "cost of improving the quality of the environment where it has been adversely affected by energy activities, and of maintaining the quality in all parts of Canada at a level up to or above acceptable national objectives", for the period 1974-1983, would be about $4-$7 billion, with about two-thirds of the total being incurred in connection with transportation. Actual costs of air pollution control equipment was about $12 million in 1970, and $20 million in 1971, with primary metals, paper products, petroleum, coal, and transportation taking up about 61% of the total in 1971. (27)

More dangerous to human health, however, are situations where these chemically active air pollutants combine with heat and light, and undergo complicated chemical reactions. These reactions are more numerous, difficult to identify and may be extremely dangerous. Of these gases, two are causing growing concern - oxides of nitrogen and ozone. The general syndrome of "photo-chemical air pollution" (smog) is bound to increase in future when the new catalytic converters are installed in automobiles because, while reducing the carbon monoxide, they raise the levels of nitrous oxides - especially in urban environments. Ozone in low levels combines with sulphur dioxide to

produce effects much greater in magnitude and more quickly than either gas alone. Deposits of sulphuric acid in the lungs, increases in mortality from heart disease, and forms of cancer represent some of the direct threats to health. Nitrous oxides have been reported at high levels in Edmonton where thermal-electric generating plants burn large quantities of natural gas. High levels of ozone have been recorded in Hamilton and the Toronto suburb of Etobicoke. (28)

Without atmospheric dispersion, of course, Canadians would not be able to live with their machines in a highly urbanized industrialized society. Transboundary movements of air pollution can be expected to increase in the years ahead. An increase in population and industrial activities (in the U.S.A.) in the areas adjacent to the Maritimes, the St. Lawrence and the Lower Fraser Valley, will bring fallout from external sources of pollution. The complex interrelationship between air, soil and water pollution produces new hazards such as rain or snow, contamined by pesticides, sulphur dioxide (the "acid rain" which Norway and Sweden have experienced) or nitrates from full combustion which then infect rivers and lakes (and even our upper atmosphere as in the case of freon gases.)

This chapter has lumped together enormously diverse and complicated issues under the aegis of the topic: Urbanization. Many serious concerns have not been touched on at all. The psycho-social problems of urban life, as reflected in crime rates, increased drug use, respiratory diseases are more clearly perceived by citizens who see their quality of life eroding daily. What Chapter 2 has picked out are some of the areas of specific concern to environmental management which are likely to increase in importance in the next 25 years.

3. ECONOMIC ACTIVITY

(a) INTRODUCTION

The level, character and distribution of economic activity in Canada has a significant effect on environmental quality, since by-products of economic activity, including unwanted and sometimes harmful wastes, have to be disposed of. In this chapter, an overview of the present economic situation in Canada is presented. In addition, an attempt will be made to postulate three future economic trends and examine their implications for environmental management. These alternatives consist of:

(1) A moderate growth trend, or a continuation of growth similar to pre-recession trends (approximately 5-5.5% average annual increase in real GNP), derived from the Economic Council's Eleventh Annual Review (1974)

(2) A slower growth trend (about 4-5% average annual increase in real GNP); this assumes continuing economic problems related to the supply of oil and other problems in securing adequate energy supplies; continued disruption of the world economy corresponding to the increase in power and negotiating ability of third world countries; decline in power and influence of the U.S.A. (and U.S.S.R) and related difficulties in insuring adequate supplies of a broad range of imported raw materials; and continued unemployment and inflation in the Canadian economy.*

(3) A faster-growth trend (about 6% average annual increase in real GNP), which assumes a major and rapid expansion of the resource sector within the next decade and effective mobilization of capital, labour, etc.

These possible economic futures are presented as benchmark projections, and are not offered in any firm, predictive sense. The time horizon for these three projections is taken as ten years, which was considered adequate for assessing significant divergences in the future, and their implications for environmental concerns.

In addition to the three previously outlined trends, a fourth projection spanning the next 25 years is presented, using a combination of the elements contained in the former three cases. (See Appendix D).

This alternative postulates an average annual real growth rate of 5.3% with a maximum acceleration in the mid 1980's followed by a slowing down of the economy and a growth rate at the end of the century

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* International developments such as these exert an important influence on the volume, nature and location of economic activity in the domestic economy. The most obvious example is the effect of decisions made by OPEC Countries on such domestic decisions as the role of expansion of the Canadian nuclear industry, the tar sands, northern oil and gas, coal deposits, etc. These developments will have major environmental impacts. Thus by influencing the nature of economic activity, international events influence the nature of environmental disruption thus constituting a legitimate concern of Environment Canada.

below that of the recent historical period (1965-1974). This projection was included in order to focus on the longer-term implications of a 25 year period for environmental management.

(b) CANADIAN ECONOMIC DEVELOPMENT: HISTORICAL OVERVIEW (1870-1973)

The general paradigm of Canadian economic growth from 1870-1973 can be seen as a trade-off, over time, between the assets which Canada had in abundance initially, (i.e., land, water and other natural resources) and those resources which, for the most of Canadian history, have been in short supply (i.e., people, capital and technology) all of which had to be imported. In mixing the latter with the former, we have tended to undervalue the natural resource base in order to attract those elements required to realize resource potential.

The historical trend of the economy has focussed on the successive development of staple products (natural resources, both renewable and non-renewable) for international markets. The economy has therefore been affected significantly by shifts in the international milieu and has evolved an economic strategy, sensitive to international demands for natural resources.

Compared to other countries -- industrialization in Canada -- occurred later, more gradually, and with significant lags and gaps. By and large, it has developed within the lifetime of the present generation of Canadians and has been accompanied by the ethos of social welfare and mixed-market political economics.

Throughout Canada's history, from the days of pre-industrial trade monopolies, i.e., fur trade to present-day DREE programs, the public sector has tended to loom large in Canadian economic life. There is reason to suggest that, in a number of respects, the forms of public-private interaction that have evolved in Canada, as part of a particular brand of mixed-market economics, are somewhat unique.

The key developmental technologies up to 1945 were those underlying supportive infrastructure, for example: (a) Large-scale transportation and communications systems (b) developments in agro-science making it possible to build up the Western agricultural economy; (c) techniques of discovery, extraction and processing of mineral raw materials and energy sources supporting the development of resources.

In the post-war period the economy entered into what may be termed as "mature industrialism." There was high growth, measured in output and dollar terms. Consideration of the costs of growth tended, for the most part, to be underplayed. While this position has come under increasing criticism in recent years, the strength of the growth orientation, firmly implanted in the 1950's and 1960's, should not be minimized as an underlying current in economic perceptions. In a period of recession or in the early phases of post-recession recovery, growth for the sake of recovery may come

to seem more significant to many people than considerations of long-term stabilization of economic patterns.

The 1970's has witnessed a many-dimensioned debate in Canada about the nature and future direction of our economy. In this debate, issues such as degree of foreign ownership and control, the state of Canadian technology, environmental degradation, and the concept of "stable state" overlapped to form a reasonably coherent set of counter-propositions about the direction the Canadian economy should take.

Simultaneously, this period saw the development of highly concentrated, industrial activity in major population centres, (particularly in the Windsor-Quebec corridor) plus the expansion of a variety of resource industries. This may have tended to fragment the perceived economic interests of the country further producing a "dual economy" outlook. On the one hand, there is a concentration of industry in Central Canada; on the other hand, an expanded resource industry, much of which lies west and north of the Ontario-Manitoba boundary. Such development hastened the concentration of population and acceleration of the conversion of farmland to urban space. The economy became more interdependent, both nationally and internationally. The so-called "ripple effect" distributed throughout much of the system, events that occurred in related areas. International developments, failures or bottlenecks in the economy, accidental disruptions -- all of these had wider and more rapid impacts. The role of government in relation to the economy grew and public expectations vis-à-vis government increased, in both the level and scope of government programs, and in the effectiveness of governmental policy intervention to achieve acceptable economic performance as measured by growth rates, unemployment and rates of inflation.

The uneven and differing economic development in the various regions of the country presently requires the development of a great deal of flexibility in policy formulation. Urban areas that contain the bulk of Canada's population and are, in the largest centres at least, in the forefront of Canadian industrial and technological development. Such centers have always had different needs and interests from the rural sector or the pre-agrarian communities of the North.

A complex, interdependent economy such as Canada has developed becomes much more difficult to manage and influence. In the short-term, lags between the implementation of measures and their taking effect may lead to the phenomenon of policy impacting after the situation has turned and thereby aggravating a given short-term fluctuation. Thus, measures taken to stimulate the economy during a recession may have a delayed or protracted impact and, by continuing to affect the economy after it has recovered, may typically "overstimulate" it. This can intensify the inflationary aspects of a rebound. Conversely, the need, in a more complex and mature economy, to

watch over short-term fluctuations can divert attention from policy areas that have long-term, slower, acting effects on structural change and overall stabilization.

(C) THE CANADIAN ECONOMY TODAY: 1973-1975

(i) 1973

The 1973 performance of the Canadian economy is assessed in the Economic Council's Eleventh Annual Review (1974) (1). The overall rate of real growth, at 6.8%, represented, for the third consecutive year, a performance in excess of what the Council considered to be the long-term average, potential growth for the economy. By 1973, this gap between potential and actual GNP had declined to about 1.5% from 3.7% in 1970. Earlier, the Economic Council conveyed a 6% growth rate (real GNP) as desirable, but a new short-term (1974-1977) objective of 5.7% real growth per year was suggested, with medium-range expansion (through 1982) of 5.5%. This was to lessen strain on the economy and make inflation more tractable.

The various sectors performed as follows:

- Consumer expenditures were higher than forecasted

- Durable goods spending increased, continuing a 3 year-trend.

- Total fixed investment increased at higher than the projected rate; machinery and equipment advanced strongly (13.9%)

- Output per person employed in all sectors was a third lower than projected continuing a declining trend.

- Aggregate output of manufacturing was high (8.2%), but output per person was 2.2% or less than half the originally rate forecast.

- Capacity was overstretched in a number of significant areas: textiles, paper, petroleum and coal, chemicals, wood, machinery, metals, electrical products.

- Very high unemployment rates existed with shortages of skilled labour in particular sectors - The Economic Council felt this arose from a "two-tiered" labour market: The primary, where skills needed for rapid resource and some industrial developments absorb males 25-55, and rapid increase in the

secondary on service employment (absorbing females, younger and older workers) arising from growth, inflation and changing social values. (The latter area has lower productivity)

- Export levels rose 40% higher than expected; import levels were two thirds above target.

- Government expenditures increased 20% less than target (4.1% instead of 5%); transfer payments to individuals rose slightly above target (13% vs 11.2%; in 1971 it was 18.3%, and in 1972, 19.7%). The Economic Council felt that the targets may be too low; inflation and indexing would ensure continued high rates of expenditure.

(ii) 1974

The synopsis for 1974 is based on the Department of Finance, Economic Review, published in April, 1975.(2) In 1974, most Western Economies were operating well below potential, due to the oil crisis and other problems in the international economy. In Canada, real GNP increased 3.7%, down by almost one-third from the revised 5.5% target for mid-1970's annual growth projected by the Economic Council. But the Canadian Economy compared well to that of the OECD group as a whole, where real growth declined from the 6.3% to 0.3% in 1973.

The various sectors performed as follows:

- Consumer expenditures dropped significantly to half the 1973 rate, or 27% below target.

- Non-durable demand was strong; durables (motor vehicles sales particularly) were weaker.

- Total fixed investment was 18% below 1972-76 target rate: Business investment was down 20% (25% below target); capital formation was minimal in the housing sector (0.8%).

- Employment increases were 4.3% (19% below 1973): Service sector increased by 4.7%, while goods-producing sector increased by 3.6%. Service sectors expanding were finance, insurance, real estate, public administration, wholesale and retail trade. Goods producing sectors expanding were construction, manufacturing, primary industries and agriculture (following years of decline)

- Unemployment decreased from 5.6% to 5.4%.

- Exports declined 1.5%, imports remained high.

- Government expenditures on goods and services, rose 19.1%, or 80% above projected rate; transfer payments to individuals rose.

(iii) 1975

A partial forecast for 1975 may help round out the survey of the recent Canadian economic situation. This is based on mid-July 1975 forecasts of the Department of Economic Research of the Toronto Dominion Bank.

The general picture is of an economy whose economic performance is declining, but phased somewhat behind that of other market economies. In general, for the OECD countries, 1975 is widely seen as the change-over year in the current recession, with the beginning of a recovery that will gather strength in 1976. In contrast, Canadian performance, which was better than that of the OECD average in 1974, is likely to lag behind OECD this year. Thus, the annual percentage change in real GNP is forecast at only 0.3% -- an increase lower than at any time in the post-World War II period.

The various sectors are expected to perform as follows:

- Consumer expenditures will run at 60% of 1974 rate.

- Housing expenditures will be 16% below 1974; housing starts 10% below 1974's already relatively low level.

- Business investment in plant, machinery and equipment will rise (14.4%), but remain below 1973 level.

- Unemployment will rise by almost 39%, to 7.5% of the labour force.

- Exports will decline substantially in real (volume) terms, despite 4.7% increase in dollar values.

In summary, the recent (1973-1975) performance of the economy, if looked at in the light of the longer-range historical trends, brings to the surface a number of points that are significant features of the economic background to environmental management:

1. The short-term volatility and stop-start nature of Canadian economic performance in recent years. This stems from the structural unevenness of the Canadian economy and has been worsened by recent high inflation rates and by the volatility of international trends. It acts to hinder the development of long-term stabilizing and structural economic policies and puts a premium on policies (largely fiscal and monetary) aimed at dealing with short-range macroeconomic problems.

2. The difficulty in generating sufficient high levels of new employment, coupled with the tendency of employment to develop in lower-productivity service areas. As these factors interact with short-term operation of the economic cycle, relatively high rates of unemployment are generated which are not likely to be brought down to acceptable levels until decreases in new entries into the job marked begin to manifest themselves in the early 1980's.

In the meantime, this employment-creation problem tends to influence other policy areas.

3. Associated with the above, the problems of long-range stabilization of business investment at an adequate level to provide for the growth in economic activity and in jobs. Investment has tended to be low, particularly in manufacturing. Environmental protection measures are seen as added costs, not easily recoverable unless steps are taken that may lead to greater inflation. The task here is to devise policies that will build environmental protection into industrial activity without threatening the overall efficiency, productivity and competitiveness of Canadian industry.

4. Relatively high levels of expenditure by governments at all levels, particularly by the provinces; a general long-term increase in the real cost of current government operations, coupled with a tendency for government to increase its capital investment to make up slack in overall fixed capital formation. If we take this together with the stop-start performance of the economy and the problem of job-creation (which has partly been dealt with through fairly high increases in public-sector service jobs), one can project increased competition, within the area of governmental expenditure at all levels, between those that show a pay-off in terms of more immediate policy concerns and those involving long-term development of the economy and society, such as environmental policies.

Thus, the general picture that emerges is one in which the nature of the economy will make it difficult to mobilize support for environmental measures whose cost will fall upon private business. While funding these programs out of the public purse will run up against increased competition from a variety of other priorities such as job creation that reflect more immediate concerns. The initiation of environmental policy as a priority area for governments was a feature of the late-1960's confidence in the Canadian economy and society, coupled with increased concern for the long-term future of Canada's environment. The mid-1970's is a period of growing pessimism about short-term prospects, resulting in a focusing on areas of traditional immediate concern. If one believes that the next decade will be critical for the shaping of policy structures aimed at social and environmental balance, then one must suggest that for most of the remaining years of the 1970's, (as the country tries to move ahead out of the mid-1970's economic crisis), immediate economic concerns will make it much more difficult to develop long-term management programs.

(d) REGIONAL AND PROVINCIAL BREAKDOWNS

The functioning of the Canadian economy cannot be understood purely in nationally-aggregated terms. The economy and society is, in large measure, a set of regional and provincial sub-systems, interacting over time, in combinations that gradually change and re-form. Figures 3.1 to 3.3 (Appendix C) and Tables 3.1 to 3.5 (Appendix B) provide a basis for exploring these regional differences in the economy.

The following points may be noted:

(1) While some progress has been made in redressing regional discrepancies (as measured by relationship between provincial or regional levels of per capita income and the national average), there is still a considerable range of deviation among provinces. Moreover, while the trend in Quebec and the Atlantic region has been fairly steadily upward (though these are still at a distance from the national average), the trend in the West has tended downward. It would appear that the search for a national average of income has occurred around a fixed point -- Ontario -- with a level of per capita income substantially above average, while the other two halves of the country have moved in opposite directions, one moving upwards towards the national level and the other moving downwards to or below the national.

(2) The range of difference in employment patterns may also be noticed. Transformation in the Quebec economy is discernible; Quebec and Ontario now have basically similar employment structures. But there is considerable diversity of structure in the other areas.

(3) Finally, and significant for the subsequent analysis, the rise in proportionate value of commodities and especially mineral resources extracted from Western Canada is shown in another series of tables. (Tables 3.2, 3.3, 3.4, Appendix B) At the present time, some 60 per cent of minerals by value are extracted in areas north and west of the Manitoba-Ontario boundary. Note that the 1973-1990 comparisons are from a study by the Ministry of Transport and that the 1990 projections are based on a somewhat slower rate of growth than is considered later.

(d) ECONOMIC ALTERNATIVES

In the remainder of this chapter, three economic alternatives through the mid-1980's will be described. A hypothetical, mixed-growth trajectory covering the entire fourth quarter-century period 1975-2000 is appended at the end of the document. (Appendix D) These alternatives should be considered in the light of the development and meaning of economic alternatives and scenarios.

For alternatives, one looks for outlines or profiles of possible futures which are consistent with both the base data and with a reasoned choice of assumptions about continuities and changes in social, economic, cultural and political behaviour.

(i) The Base Case: Continuation of Growth Similar to the Pre-Recession Trends

In its Eleventh Annual Review (1974), the Economic Council discussed three alternatives for the period 1975-1982. Variations were dependent on differences in anticipated 1980 energy prices.

For the purposes of our analysis, it is not the individual variant that is important, but rather the fact that the "family" of Economic Council projections in the 5.0 to 5.5% growth range consitutes an extrapolation of recent growth trends, prior to the 1974 and 1975 recession. Historically, this rate of growth has been labelled "moderately high". The range is approximately that of the average annual increase in real GNP during the 1950's and 1960's and is only slightly higher than the 1964-1972 rate of 5.0% real growth per year. The range is lower than the 6.0% targeted by the Economic Council in its 1973 review, and falls midway between the actual performance levels of 1973 (6.8% and 1974 (3.7%). The Economic Council's alternative may be summarized as follows: (See Tables 3.6 to 3.8, Appendix B):

(1) GNP (in constant dollars) would be about 65% higher in 1985 than in 1975. Per capita GNP would rise about 45%.

(2) There will be healthy increases in employment (averaging c. 2.9% per year);

(3) Partly due to anticipated further expansion of the service sector, labour productivity will continue to be a weak point in the economy, lagging behind the historical growth trend 2.2% per year.

(4) Some structural shifts will occur in the economy most of which will have a major influence on environmental quality. First, additional investments will be required for the development of natural resources; secondly, the age structure of the Canadian population will shift to an "aging society"; and third, there will be a transition to full productive capacity in some sectors. Finally, external trade, whose vigorous growth was a significant factor of economic expansion in the 1960's is projected to slow down.

(5) Some shifts will take place in the composition of GNP. The most significant increases in growth rates of output will occur in the following sectors:

(a) Non-Renewable Resources (particularly energy resources and minerals);

(b) Construction (related to the above, but tending more to engineering than residential construction);

(c) Agriculture;

(d) Forest products.

Associated with developments in these areas will be various impacts on the location of economic activity. The strains on remote, often ecologically fragile, areas of Canada will increase.

(6) Consumer expenditure will increase across the board, but with a particularly strong demand for services (rather than goods).

(7) The balance of payments deficit on current account is expected to diminish somewhat, partly because of the energy situation. Some reduction in the rate of energy consumption and more volume from domestic supplies are expected to reduce energy imports. On the other hand, if domestic energy supplies are expanded sufficiently, and exports continue, higher international prices for petroleum and natural gas should help further offset negative aspects of balance of payments.

(8) Throughout this period, the dominant influence on the economy was expected to be investment requirements, particularly the need for capital for resource development. In the light of these very formidable capital requirements, much more capital will have to be imported, thus contributing to increased surplus in balance of payments on capital account.

(9) Total government expenditures will grow at a slower rate than in recent decades.

(10) In the shorter period, 1975-1982, it may be possible for Canada to achieve an average rate of real growth of between 5.1 and 5.5% per year. But shifts in the internal balance of the economy suggest that, over any longer-term, the rate of growth would be reduced below levels consistent with recent historical experience.

(ii) A Lower Growth Alternative

Currently, there is widespread belief that the average rate of growth of real GNP during the next decade will be somewhat lower than the historical rates extrapolated by the Economic Council in 1974. A 4.5% average growth rate for the next 10 years was recently (1975) developed by a private Canadian economist, Dr. Arthur W. Donner. (3) 'Essentially, Donner bases his analysis on a combination of resource development and population trends, against a background of continuing high inflation. His analysis focuses on the friction resulting from bottlenecks in the economy and the way these can lead to a lower rate of expansion.

The main points of Donner's analysis are as follows:

(1) Because of anticipated shortages in the Canadian labour force, relative to economic expansion, there may be a reversal of the current momentum to restrict immigration flows in Canada.

(2) Resource industries (mining, agriculture, forestry, energy) have registered higher productivity gains than the economy as a whole and will prove less vulnerable than other sectors to problems of labour supply.

(3) The nationwide unemployment rate will probably average lower between 1975 to 1985 than during the preceding decade.

(4) A further shift in consumer priorities, away from youth-oriented consumption, will result from an anticipated increase in the 30 to 39 age cohort of 46% between now and 1985 (from 2.8 to 4.1 million) plus an increase in the number of those over 65 and a decrease in the 1-14 group. Priorities in the public sector will shift from education and other youth-related services to provision of income security for an aging population.

(5) Seasonal industries (including summer tourism), recreation and service-related employment (e.g., low level clerical jobs) tend, particularly in the part-time employment sector, to be heavy employers of younger people. Such industries will be affected by the slower growth of the younger work force -- though there may be a shift to part-time employment of older pleple and increased employment of women.

(6) The demographic shifts may also imply considerable increases in personal savings (among the 35-64 age group)

(7) Agriculture, public administration and manufacturing are unlikely to expand as rapidly as the economy as a whole. But most service industries will grow more rapidly than the economy.

(8) Growth of the resource sector will lead to increased demand for capital goods; government policy may seek to displace reliance on imported machinery and equipment by domestic product.

(9) Non-governmental service industries will provide the most rapid increase in job opportunities, with business services leading within the sector. Other service groups (finance, insurance, real estate, public administration and trade) will experience above average rates of growth.

(10) Inflation will not subside for several years, though it should peak in 1975. There is a real danger that Canadian inflation, at unacceptably high rates, will persist over a longer time-span than that experienced by our major trading partners.

(11) A general consolidation of existing structural and geographical patterns of economic activity would take place; little expansion would take place in new resource areas.

In sum, this scenario would basically consolidate existing structural patterns of economic activity. Gains in material well-being would result more from declines in population growth rather than structural shifts or technological maturation within the economy.

(iii) A Higher Growth Alternative

A higher (or faster) growth alternative - in the vicinity of 6% average annual increase in real GNP --- should also be considered for the 1975-1985 period. This rate is about 20% higher than the 1964-1972 average and about 10% higher than the highest rate envisaged by the 1974 Economic Council Review.

(1) A higher average growth rate would strain economic capacity, transcend medium-range economic potential; and produce continuing high rates of inflation.

(2) There may be an underlying tendency to assume that Canada, as a mature economy, has already reached the point where a long-term decline in the rate of growth must "inevitably" set in.

(3) Some preference for "balance in the economy may restrict our willingness to consider such high growth.

In response to the above, the following points may be considered:

(1) Historically, it can be argued that, in each successive period, the rate of real growth has been higher than what could have been forecast earlier.

(2) In pursuing high economic growth, the consensus of opinion is that the growth would not be "balanced", i.e., allow for effective short-term demand management. However, the widely-accepted Hiyschman-Lindblom theory of economic development argues that the "unbalancing" effect is central to the developmental process.

(3) If one accepts the concept of a "dual economy", with mature industrialism centered in the Windsor-Quebec corridor, and widely-dispersed resource development and industrial development geared mostly to resources elsewhere, then it is possible to consider strong economic growth and development in the resource sector, which may in turn generate stronger economic growth in the industrialized "core".

(4) Short periods of high economic growth can also be envisaged, to develop the economy sufficiently in certain sectors, in order to reach a "steady-state" situation at some future date. Stabilization may only be possible after an economy has reached an overall maturity, technological competence and relative international strength.

A higher growth alternative would have the following positive features:

(1) Real GNP would be 80% higher in 1985 than in 1975; per capita GNP would be 63% higher.

(2) Growth would be led by investment and development in the energy sectors; security of energy supplies would be enhanced.

(3) Beginning in the 1980's, rapid resource development would occur.

(4) Large expansion in transportation and communications infrastructure would occur, primarily to service the resource sector.

(5) The industrialized sector would grow rapidly in areas related to energy and resource development (steel, building materials, transportation equipment, etc.)

(6) Heavy demands on investment would peak in the mid 1980's; bottlenecks would occur with regard to investment capital and labour - this would probably lead to large-scale importation of capital and increased immigration and/or restructuring of the labour force away from the service sector to the resources/industrial sector. (This would enhance productivity)

(7) Beginning of a significant development of a second industrial base-area in Alberta and British Columbia;

(8) Possibilities of some drawing away of population growth from the Windsor-Quebec City corridor area (though this would have both positive and negative aspects, in view of the difficult land use questions associated with urban development in the West);

(9) Virtually full employment and some upgrading in the level of employment that is available;

(10) Enhancement of the material standard of living; (the extent to which this would be a boom would depend on the way in which it is distributed and the types of consumption choices that would be made);

(11) A higher and more secure revenue base for governments as they begin to move towards the late 1990's situation where a rise in social expenditure will once more be called for:

On the negative side, rapid growth would have the following negative features:

(1) Various bottlenecks particularly in investment capital, skilled labour; construction materials, availability of technology, etc.;

(2) Significant dislocation in existing economic structure, particularly in the manufacturing industry located in central Canada;

(3) Reinforcement of high inflation;

(4) A tendency for the price of Canadian manufactured goods to be pushed to non-competitive levels in world export markets;

(5) Increased pressures on the environment and strains on capacities to engage in environmental protection and long-term environmental management;

(6) Reinforcement of "growth for growth's sake" attitudes;

(7) Increased competitiveness among all sectors of the economy, among regions and among levels of government for available capital and labour.

In sum, much of our assessment depends on how optimistic we are that the dislocations intrinsic to this type of growth could bear fruit in the longer term in a transformed and more mature economy and society.

(iv) A Hypothetical Mixed Growth Alternative, 1975-2000

A fourth alternative to be found in Appendix D attempts to piece together elements of the preceding analyses and extend our thinking to the year 2000 by elaborating one of many possible developmental paths. What is suggested is a rate of growth that increases under the stimulus of high resource demand and low population growth, peaking at an average rate of 6% by the mid-1980's and then gradually declining to a 4.5% annual rate of increase in real GNP in the closing years of the century. On average, according to the trajectory that is considered, the rate of growth would be about 5.3% per year, in real terms.

4. RESOURCES

(a) Introduction

The settlement, support and well-being of Canadian citizens is ultimately based on the exploitation of resources, whether at the international or national level. Economic activity in the past 100 years generally operated on a short-term assumption of unlimited resource supplies. The "Limits to Growth" controversy has challenged this assumption by pointing out the possible consequences over the long-term of continued resource exploitation at rates which may not be viable. There is also a growing awareness of the direct and indirect costs of unplanned resource extraction, and lack of adequate resource management.

A brief overview of resources is considered here. Agriculture, ocean fisheries and forestry are treated because of their economic importance to Canada. Other renewable resources such as wildlife, fur-bearing animals, and inland fishing constitute an important recreational and economic resource but only to certain segments of the population. The discussion of non-renewable resources is confined to minerals. Fossil fuels are discussed in the subsequent chapter on Energy.

(b) Renewable Resources

Environmental deterioration (aside from natural disasters) usually stems from the excessive pressure of human activity on renewable resources. Human intervention in natural processes, whether for consumption or preservation, will require increasing attention to ensure that the long-term effects on ecosystems do not cause irreversible damage.

A AGRICULTURE

The focus in this section is on the production of food in Canada rather than marketing or consumption patterns. While the increase in food production is a major concern of Agriculture Canada, the long-term environmental impact of production methods, land use practices, energy subsidies, and water demands are clearly related to broader future Canadian concerns.

1. The Global Perspective

Table 4.1 (Appendix B) prepared by Lester Brown for the World Food Conference, shows world food reserves since 1961. These reserves have been generally declining relative to the world population. While Canada, the United States, New Zealand and Australia produce about one-tenth of the world grain supply, they were the only countries with a grain surplus in fiscal 1974. These countries have historically occupied a position of new exporters of grain since about 1950; the rest of the world have been net importers (Table 4.2, Appendix B).

In terms of comsumption, poorer countries consume grain directly (about 400 pounds per capita per year). A European eats 1000 lb. of grains,

both directly and indirectly (meat, dairy products, etc.) while a North American consumes 2000 lb., only 150 lb. of which is consumed directly.(1) Domestic animals consume far more food than people, and are highly inefficient converters of protein (about 4.12 lb. of grain protein to make one pound of meat protein overall).

As food requirements increase, the intensity of agricultural practices and inputs will need to grow to meet global need. World fertilizer consumption is expected to rise from 60 million metric tons in 1970 to between about 200 and 600 million metric tons in 2000. Energy consumption for agriculture is expected to rise by at least the same relative amount.

Some major agricultural problems facing many nations are:

-growing shortages

-available water is being increasingly contaminated by fertilizers, pesticides and fungicides, as well as surface "salt" contamination from rising water tables caused by improper irrigation

-soil depletion - caused by poor tillage, overgrazing, single-crop farming, wind and water erosion, semi-arid grasslands devegetated by over-grazing, threatening to produce true desert conditions, deforestation causing loss of surface water, disruption of rivers and valleys(2)

-loss of food to pests - estimated to be about 20% of the world's yearly food supply (yearly crop); in addition, after harvesting, FAO estimates losses of about 33 billion tons of stored food per year(3)

-continued fluctuation in supply due to climate, and possible long-term climatic changes which some scientists claim could be affected by "atmospheric pollution"

2. Canada's Agricultural Capacity

Because of climatic and soil limitations, only about 7% of Canada's land is suitable for agriculture. Much of this land is also wet, rocky or steep.(4)

Figure 4.1 (Appendix C) shows present and potential agricultural land in Canada. Approximately 174 million acres, as yet undeveloped, might be brought into production, but these are either in climatically unfavourable areas or will require large capital and energy investments to make them viable.

The great bulk of good arable land is situated on the prairies or in the Windsor-Quebec corridor. Twenty-four million acres of climatically-favoured, best soils lie in the lower Fraser Valley, Southern Ontario, and the St. Lawrence Lowlands.(5) Class 1 soils on the prairies have a lower productive capacity and a narrower range of crops than Class 1 or 2 soils in Southern Ontario.(6)

There has been a steady decline in farmland in Ontario and Quebec as well as the Atlantic provinces since 1921, while increases took place in the

Prairies and British Columbia (albeit into less favourable climatic areas, Figure 4.2). In the period 1951-71, losses of Class I-III farmland in the Quebec-Windsor corridor (an area which contains 60% of Canada's population, 80% of its industrial activity, and 40% of its agricultural production) were in excess of about 7 million acres, half of which were improved land.(7)If current trends continue, Nowland (1974) predicts that from 1971-2001 another 0.7 to 1.2 million acres will be lost to urban development in this region.(8) While figures vary in different regions, Williams (1973) estimates that the amount of farmland diverted to built-up urban use approximates 100 acres of our best agroclimatic and soil resources for every thousand increase in population.(9)Figure 4.3 shows agricultural land lost to urban development in Edmonton and Calgary between 1966-73.

The relatively poor areas in Canada, from an agroclimatic standpoint, contain the largest amounts of farmland. Those areas which are relatively good from an agroclimatic standpoint encompass only small amounts of farmland coupled with large urban populations. The percentage of urban population occupying the best farmland (cumulatively) are:

Percentage Urban Population:	4	33	50	74	80	81%
Percentage Farmland Acreage:	1	2	5	20	50	66%

That is, 66% of the best agroclimatic farmland is affected by 81% of the urban population.(10)Since agriculture is so important for Canada's export trade (from $1.8 billion exported in 1970 to $3.0 billion in 1973), urban growth on Class 1 and Class 2 agricultural lands has become a recognized problem for the longer term. Diversion of urban growth to non-farmland will require much more integrated planning if prime agricultural land is to be protected from further encroachment.

3. Other Factors Affecting Agricultural Practices

(i) Water

It is expected that the competition for water resources is likely to intensify in the future. Increased urban growth and water needs for energy, mining, and manufacturing is expected to increase the pressures on this resource in future. Canadian agriculture has depended mainly on precipitation for its water supply. In the future, attempts to intensify agricultural production or increase acreage will increase the demand for clean water (in 1972, agriculture consumed 7% of all water used in Canada).(11) Tables 4.3-5 show water use in Canada by region for all sectors.

Water resources are unevenly distributed in Canada:

Atlantic region-supplies are generally adequate

Quebec-supplies generally adequate but may be of poor quality near some urban areas

Ontario-abundant rainfall with irrigation to protect the soft fruit and tobacco crops in Southern Ontario

Prairies-adequacy of supply a major problem: the southern prairies are one of the most intensively farmed areas, yet contain the poorest water resources in Canada

British Columbia-mountains cause variations in precipitation so that land near CMA's like Vancouver and Victoria suffer from water deficiencies (Table 4.6, Appendix B)

As far as municipal water requirements are concerned, capital costs of treating waste water can be expected to increase in those centres where population growth is greatest. Project growth will require greatly increased financing of capital projects to treat water in future if supplies are to be available for competing users. In terms of waste loadings, removal efficiency has, on average, been about 45% over all regions (Table 4.7-4.8).

The advent of large-scale nuclear generating plants has important implications for water use and future competition among users. Table 8 shows estimated water withdrawals for thermal generation for 1972. Pickering alone used 1,670,000 gallons per day in 1973, returning this water to Lake Ontario, with a temperature rise of some 20^{O}F.

Canadian agriculture has depended mainly on precipitation for its natural water supply. Attempts either to increase acreage under cultivation or to intensify present agricultural land-use will, in the future, augment demands for clean water. In this respect, irrigation and stock watering account for 69.1% of Canada's agricultural water use.

The agricultural sector withdraws clean water but often returns it to the environment in a polluted form. In Canada, pollution occurs by chemical inputs (fertilizers, herbicides, pesticides, and animal wastes), and erosion (wind, water and deforestation) leading to silting. Unlike water polluted by industrial activity, agricultural run-off cannot be recycled but must be treated usually by municipal facilities.

(ii) Energy in Agriculture

There are two ways to expand food production: plant more acreage and/or harvest greater yields from current croplands. Since much of the best agricultural land in Canada is already in use, expansion into areas of marginal fertility (Figure 4.1, Appendix C) will require large inputs of fertilizers, pesticides, irrigation water and the energy required to cultivate, harvest and transport crops to markets. Erosion, leaching, and water quality problems may follow. However, the greatest risk may be the climatic problem of agricultural development into northern areas where the number of frost-free days may decline further in future.

The techniques used to boost yields will also require similar greatly increased energy inputs. In 1966, 28% of all petroleum products marketed in Canada were used in agriculture and food production, and 20% in the agricultural chemical industry.(12)While most fossil fuel inputs to agriculture (particularly the chlorinated hydrocarbons) can be produced using coal, the energy inputs in the conversion processes are also high.

Table 4.9 shows energy inputs for Canadian agriculture production in 1971, comparing energy equivalents on a per acre basis (note 4 BTU's = 1 K cal.).(13)MacEachern (1973) has calculated that 30 cents of energy resources were purchased directly and indirectly by farmers to produce $1.00 output.(14)Although only 39% of Canada's farms use fertilizers on 22% of the farmland, the top one-third (95,000 farmers) used 75% of the fertilizers, 75% of the chemicals, and 50% of the petroleum products.

Conventional oil reserves are expected to decline in Western Canada after 1982, and Canada would remain almost 50% dependent on foreign supplies. Thus future energy price changes will strongly affect food costs. From 1961-1971, farm costs rose 47% overall, under rather stable energy prices. During the next decade, according to MacEachern, they may rise another 40% due to energy costs alone.(15)

(iii) Air and Climate

The effects of air pollution on humans has been reasonably well-documented. What is less well known is the effect of these chemicals on plants.

Many plants are sensitive to ozone and elevated concentrations frequently occur over large areas near the more densely populated regions.(16) Linzon has described the adverse environmental effects on plants of such chemicals as fluorides, nitrogen oxides, chlorine, ethylene, ammonia, mercury, and particulate matter (such as cement-kiln dust, carbon soot, aerosols, etc.).(17)

With respect to climate, we enter a field where much research is under way and conflicting opinions exist about the significance of certain trends. Some climatologists believe that there is a fairly drastic climatic change going on which may affect food production capabilities in the future. From 1900 to 1950, the Northern Hemisphere enjoyed a relatively benign climate (Figure 4.4 and 4.5, Appendix C). Since 1950 an apparent cooling trend has been observed which the "greenhouse effect" of carbon dioxide may have slowed somewhat. However, exact causes and effects are still in dispute.

A calculation of the annual mean temperature of 0^{o} Celsius for Canada has been computed for two years, 1941 and 1972 (Figure 4.6, Appendix C).(18) This figure should be viewed as an example of the wide variability of the shift of the 0^{o}C isotherm. At present there is dispute over whether a significant and persistent long-term climate cooling trend is occurring for Canada. Whether or not this is the case, the 0^{o}C isotherms indicate that expansion of agriculture into marginal lands may be too risky for the long term. It appears preferable to develop hardier crop species with shorter growing seasons, encourage more intensive cultivation in agro-climatically favoured lands, control land use, and encourage less mono-culture. 1972 was a bad year globally, but a decline in the mean annual growing days has been occurring because of shorter periods of frost-free days.

The significance of this trend for Canadian food production can be seen when one considers actual and potential agricultural lands. Most of the

potential agricultural lands are situated north of the warmer, more stable climatic areas. If a continuing cooling trend persists, the more southern, warmer agricultural lands will become more and more important for food production. These are the areas where most urban growth occurs. Such lower temperatures can affect the amount of food we produce, as well as increase the energy subsidies required to maintain high yields.

4. Environmental Implications

Because future global and national demand for food is bound to increase in the next 25 years and beyond, long-term environmental management of land, water and air resources becomes increasingly imperative. This means conservation of suitable agricultural lands, development and preservation of adequate water supplies for crops, continuing energy supplies and other chemicals needed for agriculture - while at the same time ensuring that agricultural practices do not lead to the deterioration of the physical environment as a whole.

B FISHERIES

1. The Global Perspective

The ecological undermining of major food-producing systems is nowhere more publicly apparent than in the area of ocean resources. Until recently the oceans were viewed as an almost limitless source of protein but the outlook has altered sharply in the past few years. From 1950-70, the world fish catch climbed steadily, more than tripling from 21 million to 70 million tons.(19)Since then, the catch has declined for three consecutive years - even while the capital, energy, technology and effort extended to bring in the catch continues to rise (see Figure 4.7, Appendix C). If this decline in marine protein supplies continues, or prices increase, the result will be an additional shift in demand to land-based protein resources.

The world fish catch was about 65-70 million metric tons during 1970-73, well above the world beef output.(20)China leads the world in fresh-water catch, primarily as a result of the extensively managed production of fish in ponds. About two-thirds of the world catch is used for direct human consumption, with the rest consumed indirectly either as meal or fertilizer.

Many marine biologists feel that the global catch of table-grade species is already at a "maximum sustainable" limit. However, in Canada as elsewhere, there are certain species which remain unexploited because of existing low commercial demand.

At a time of increasing world demand for protein, some national fisheries are experiencing intense international competition - the "Cod War" of 1973 between Britain and Iceland, the Russian and Japanese conflict in the Pacific, the U.S. and Peru and, more particularly, the Northwest Atlantic. As the catch of table-grade fish declines, some particularly vulnerable populations (Japan and Russia) will be forced to step up imports of other grains to supply their needs, thus exerting greater pressure on exportable food supplies.

2. Canada

While the dollar value of the Canadian fish catch has been rising over the years (see Figure 4.8-4.9, Appendix C), the annual amount of fish taken has declined from 1969-73. In 1968, 1500 thousand metric tons worth about $185 million was caught; by 1973, 1150 thousand metric tons worth $320 million was caught (dockside value). The effect of inflation on fisheries has tended to mask the decline in amounts caught. There has also been a decrease in the average size of the fish caught.

Table 4.10 shows the relationship of Canada's fish catch to the world take 1967-73. As a percentage, Canada's fish catch by weight has dropped from a high of 2.34% in 1968 to 1.75% of the world total in 1973. About 2/3 of Canada's catch was exported in 1973.

In terms of amount, the Northwest Atlantic fisheries have contributed approximately 80% of the total Canadian fish catch between 1967-1973. In 1973, this was 77% or $285 million.(21)While the Atlantic catch has been declining, fish landings have risen in the Pacific for the last six years, reaching 388 million pounds for a value of $130 million by 1973. The decline in 1975 was primarily caused by a strike. Salmon represented $100 million of the total, at 185 million pounds. Inland Waters fisheries landed 90 million pounds, valued at $16 million (Table 4.11, Appendix B). In terms of species, cod, herring, haddock, Atlantic salmon, and halibut showed decreases in landings over the last five years.

One of the world's oldest fishing grounds, the Northwest Atlantic, is in danger of further decline unless additional action is taken (nationally and internationally) to protect and reverse the declining harvest in certain economically important species. By 1972, the Soviet Union was threatening to displace Canada as the nation with the largest catch, with Poland now in fifth place. If quotas fail, other stronger measures may be required to deal with the problem of establishing an optimal stabilized yield for the benefit of all users over the long term.

Another problem for east coast fisheries management, related to declining catch, is the number of people whose lives continue to be affected by shifting economic realities. There is an estimated total of 77,000 persons engaged in the fishing industry in Canada, either as fishermen or employed in fish processing plants - less than one per cent of the labour force (.93%).(22) Of these, 13,000 are working in British-Columbia (17% of total) and 49,000 on the east coast. Federal programs to aid fishermen by income supplements and catch insurance programs may not be sufficient to sustain a viable industry if catches continue to decline.

In order to produce a long-term, viable fishing industry on the Atlantic Coast, certain steps could be taken:

-better control and regulation of fishing grounds

-possible reduction of number of fishermen

-development of more extensive aquaculture systems which have high market return (e.g., lobsters, shell-fish, oysters, etc.), although Canada is climatically not too suited for aquaculture and problems exist for its widespread growth, i.e., nutrition, disease, legal problems of tenure to water bodies

-provision of alternate employment opportunities

-possible exploitation of other fish species to stimulate new work and products.

The Pacific Coast presents a different picture. The nominal catch rose for the sixth consecutive year to 183.8 thousand metric tons with a market value of $285 million (of a total market value of $733 million for all fish). Thus, while Pacific fishing represented only about 20% of the Canadian oceanfisheries in 1973, it generated approximately 40% of the total fisheries revenue. On a provincial basis, British Columbia salmon is the most valuable species in Canada. It is important that this fact be recognized when long-term activities affecting salmon breeding areas are being contemplated, such as hydro and nuclear development projects for British Columbia, as well as considering programs aimed at increasing the supply and quality of the catch.

For example, a study in 1971 showed that construction of the proposed hydro-electric dam in Moran Canyon on the Fraser River would destroy all anadromous salmon stocks upstream of the dam and reduce salmon returns to the downstream by 50%.(23)The life of a dam is estimated at 70 years. If the dam were built today, the value of the loss of the salmon resource over the estimated life of the dam is $566 million in 1972 constant dollars.(24)

3. Environmental Implications

Resource management involves trade-offs and future irreversible consequences are part of the equation. If hydro dams are not built in British Columbia, the energy needs of a growing population will have to be met by nuclear power in the next 25 years. This requires large amounts of water and has other well-known, potentially undesirable legacies for the future.

A possible cooling of the Canadian climate could also adversely affect this important food source, e.g., the spawning habits of salmon are dependent to a great degree on water temperature. It has been estimated that the production of Pacific salmon could be doubled through intervention and effective resource management (i.e., positive enhancement). Already the Pacific herring has returned after a 10-year moratorium - only to be harvested by Russian and Japanese trawlers.

On the East Coast, restructuring of domestic fishing fleets, trade, and control of foreign fleets should be undertaken if stability over time is to be achieved. Rationalization of support for a large underemployed population needs to be re-examined. If new work in the form of aquaculture is undertaken, further environmental protection of ocean waters may be necessary.

While aquaculture may provide new opportunities for East Coast fishermen, they will still have to contend with other possible threats: petroleum

exploration and possible extraction, ocean mining, effects of transportation activities; effluents from industries, coastal cities and inland river systems (especially the St. Lawrence). Finally, the prospect of large tankers carrying both oil and chemical compounds from the Arctic to refineries in the South and passing through Canada's fishing grounds on both the East and West coasts, will contribute further in the future to the uncertainties surrounding Canada's fisheries resource.

C FORESTRY

Forest lands cover over two-thirds of Canada's land area south of the 60th parallel and form the basis of a forest industry with sales of $7.5 billion in 1973.(25)Of this, $3.1 billion was wood products (about half softwood lumber), and the other $4.4 billion was pulp and paper. About 45% of the total value of shipments and almost 40% of domestic consumption goes into housing.

Production in Canada's forest industries has grown steadily since 1950:

	Lumber (mbf)	Wood Pulp ('000 tons)	Newsprint (000 tons)
1950	6,948	8,473	5,279
1960	8,013	11,461	6,739
1970	11,270	18,308	8,719
1973(est.)	15,970	20,506	9,140

Exports have also grown, with lumber exports more than doubling since 1960 (to 9,969 mbf), as did wood pulp exports (2,602 thousand tons to 6,517), while newsprint exports rose about 1/3 (see Table 4.12, Appendix B). Almost half of Canada's production is exported, primarily to the United States but with growing markets in Europe and Asia (notably Japan).

Canada is a major source of forest products for world markets, with 10% of the world's area of productive forests and industrial roundwood production, and 17% of the conifer (softwood) growing stock.

The world demand for forest products is expected to increase 50% by the year 2000, due to population expansion, economic growth and growing shortages of timber, particularly for the softwood species so valued for construction and paper products. The demand for industrial wood should double by the end of the century and triple for pulpwood and fibreboards made by a pulping process. In addition, whole new markets will be opened as less-developed countries generate new demands or change traditional practices (such as changing construction practices and the declining importance of wood used for fuel in Japan), and as new and improved products are developed. The energy consumption aspects of wood, as well as paper, relative to the products which they can and do replace, could have a major impact on increasing demands further than earlier estimates.

These trends will result in increased demand for Canadian forest products, due to the quality of our wood, technological capabilities, and relatively low intensity of present use. The key United States market is seen as demanding a larger proportion of its requirements for wood and paper products from imports, primarily from Canada (Table 4.13, Appendix B). Lumber imports to the U.S.

represented 16% of consumption in 1970, and have been projected to rise to 30% by 2000 or more than double. Wood pulp imports will rise from 3.5 million tons in 1970 to 8.6 million tons in 2000, or an increase of 150%. U.S. paper and board imports will rise from 7.2 million tons to 11.3 million tons in the same period. Canadian domestic demand (Table 4.14, Appendix B) has been projected to rise to an annual growth rate of 1.9% between 1970 and 1981 for softwood lumber, 3.9% for wood-based panels, and 7.5% for paper and board.

The more-than-doubling of imports of Canadian forestry products by the United States between 1970 and 1980 is due to inadequate supplies of timber largely due to higher cost of extraction, diminishing size and quality, resource depletion and the removal of large areas of forest lands from production for other uses (such as parks, urbanization and energy development). This trend is occurring elsewhere, but the widening gap between supply and demand is particularly evident in our major market.

The question of whether Canada can meet this demand in the economic and resource yield sense and leaving aside environmental implications, has been widely debated, and the answer depends on assumptions concerning forest management practices. A recent study (see Table 4.15, Appendix B) indicates that timber cut could be doubled in Canda, most notably softwoods in Northern B.C., and hardwoods (poplar) in the West-Central (Prairie) provinces. The estimates assume current technology, as well as present levels of forest management. These surpluses could be increased further by intensified forest management (insect, disease and fire control, fertilizing, thinning, etc.), and more concentrated use of forest lands. On the other hand, use of this timber is constrained by logging costs, and nearly two-thirds of the indicated softwood surplus is available only at costs which exceed currently feasible levels. Most of the hardwood surplus is in "inferior" species, not used in great quantities in existing products and processes. In addition, the withdrawal of lands for purposes such as recreation, watershed management and other "ecological" requirements, has not been taken into account. Thus, the availability of quantities of raw material for expanded production is dependent on improved harvesting and conversion technology, the development of new products, and more intensive forest management practices. This will require a reconciliation of timber production and environmental considerations, as well as significant increases in the relative prices for forest products. Other factors, not directly related to the resource, include the availability of investment capital during a period of high demands for other purposes, and of skilled labour, which will remain a severe problem for forestry operations.

Environmental Implications

While only two-thirds of one per cent of merchantable timber is actually removed each year for industrial purposes (and almost an equal volume is destroyed by insect, disease and fire), such operations clearly have a significant impact on the environment and on other users of the forested area. This is especially important because use for most purposes (e.g., timber production, recreation, scenery, watershed management) tends to be concentrated around the more populated areas. In addition, the production and use of forest products can have environmental effects, not all of them negative, ranging from severe pollution through to conservation. From processing efficiencies to the energy savings implicit in using wood versus plastic or metal products, from long-term litter problems to biodegradable packaging.

The environmental implications are complex and numerous. Chemical treatments (herbicides, insecticides, fertilization) can affect water quality and wildlife. Silvicultural thinning creates noise, affects soils, run-off, wildlife and recreation. Road building is a primary cause of erosion, stream sedimentation and blockage, and disturbance to fauna. It also provides increased public access and thus danger of fire and wildlife depletion. Logging can lead to erosion, impacts on water courses, destroying protection for fish and wildlife, affecting recreational aesthetics, and creating noise and pollution. The leaving of logging debris results in severe danger of insect, disease and fire outbreaks, and difficulties for reforestation, wildlife and human access. Reforestation practices can establish monocultures with possible effects on a variety of flora and fauna as well as increased susceptibility to disease and pest outbreaks. The Conversion Process presents problems associated with land use (locational, visual and noise implications) as well as the pollution of air and water. Disposal of waste and used forest products, especially paper, can pose waste management problems. Only about one-fifth of paper produced is recycled: waste paper and cardboard accounted for 40-60% of municipal waste, up to 60% of highway litter.(26)

The environmental consequences of the production of forest products must include an assessment of the benefits of using paper and wood (Table 4.16, Appendix B). The advantages of forest products are that they are biodegradable and derived from a renewable resource which, if wisely managed, can be continually replenished. Forest products have a relatively low net energy content in comparison with competitive products: lumber takes about 1/5 the amount of energy on a value basis, than cement or steel; paper containers have net energy costs after combustion as municipal refuse, about 12% that of glass, 29% of metal, and 68% of plastic. Further, the insulating properties of wood building materials may save energy for heating of buildings.

In terms of pollution of the wood products industry, lumber has been shown to have a very low remedial environmental cost: 4-8% that of concrete, 7% of aluminum, and 22% that of steel (see Table 4.17, Appendix B). On the other hand, the pulp and paper industry has been widely recognized as a major polluter of both water and air, not only because of the manner in which it has traditionally disposed of its process waste, but also because it is a very large user of water (2,417 million gallons per day or 39% of the withdrawal use of water by primary manufacturing in 1972).(27)Pulp and paper will have high pollution control costs to meet current standards. Canadian investment has been estimated by the OECD to be $681 million during the period 1971-1980 (1970 value and exchange rates of the U.S. dollar).

One aspect of forestry which has been receiving increasing attention is the use of forests for recreational purposes. This is usually an extensive, non-consumptive use of the resource, although over-use, damage to growth, and fires can be problems. Carrying capacity both in terms of technical resource-conservation, and the more subjective recreation quality aspects (wilderness versus intensive camping experiences) has been and remains a major concern of resource managers. Effective management may require rationing and control of activities, and thus possibly user fees. The other major problem is the conflict between recreational and industrial use of the forests, especially in areas close to cities. The simultaneous pursuit of logging and wilderness is impossible. However, multiple-use management which separates and integrates users either spatially or over time can be accomplished. With increasing demands on forest land, the optimal pattern in the future will probably be that of multiple use. Good forest

management can actually improve the value of forests for wildlife and a wide variety of recreational pursuits.

In conclusion, it is apparent that a major effort will be required towards ameliorating the environmental impact of forestry practices and forest products production. This is in addition to increasing the intensity of forest management for timber production, increasing conversion efficiency and developing new products. These problems will become more severe as production is expanded. Research into the impact of these forestry activities, methods to overcome and prevent environmental damage and the implementation of environmental design criteria should receive increasing attention. Increasing demands on the forest for production and other social needs will require more reliable criteria for assessing optimal forest land use and ensuring the long-term preservation of productivity for the allocated single or multiple uses.

Pollution abatement must be pursued vigorously. This means that provision must be made for meeting the sizeable capital and additional operating costs for such control. Simultaneously, it must be realized that the social benefits from such activities will increase even more rapidly as alternative products become more expensive to society. This is in terms of actual cost as well as the environmental and energy requirements of using such materials as compared to those derived from forest products.

A problem of growing consequence for the future will be the development of techniques and economic incentives for the recycling or further use (such as energy generation) of paper products, since these products are a primary contribution to the solid waste crisis facing Canadians. This will require a major shift in the structure, production technology and sources of supply of the industry, as recovered paper becomes an increasingly large factor in pulp furnish. In addition, this could have a significant impact on the requirements of virgin fibre from forests, the associated infrastructure and sources of provincial government revenue. An associated matter will be the increased use of by-products and presently discarded material. This will arise particularly in areas such as new energy sources and petro-chemicals such as the use of spent pulping liquors as wood product binders, sawdust, bark and screened material.

The future of forestry should be one of sustained increase in demand, new markets and products (including substitution of existing products for new forms), increases in multiple use of forest lands, coupled with increasing attention to the environmental side effects of all types of forestry activity.

D NON-RENEWABLE RESOURCES - MINERALS

(i) Introduction

The mineral sector (including the mineral processing industry but excluding fuels) makes an important industrial contribution to the Canadian economy. It also impacts significantly on the physical environment and on the health of Canadians.

The mineral and mineral processing sector represents about 4.2% of GNP; in 1973, the total value of its production was about $4.9 billion, and crude and fabricated minerals represented about 20% (or $5.02 billion) of Canada's

total exports of $25.2 billion.[28] The export of metals and mineral products represented about 30% of Canada's total commodity exports, or more than 40%, if manufactured goods of mineral origin are included. About 60% of Canada's total mineral production was exported in 1973. The major recipient of Canadian exports were: U.S. (about 60%), Japan (about 13%), EEC (about 9%), U.K. (about 8%), and other countries (10%).

Canada produces over 60 different mineral commodities, and meets most of its own mineral requirements, with the exception of a few minerals such as tin, manganese, chromium, phosphate and bauxite. Seven major commodities account for about 90% of the production value from Canadian metal mines: copper, iron ore, lead, molybdenum, nickel, uranium oxide and zinc. In terms of worldwide mineral production value and diversity, Canada ranks third after the U.S., and U.S.S.R.

In terms of employment, about 150,000 people are directly employed in all aspects of the mineral industry, from exploration to refining. The mineral industry provided direct and indirect employment to about 12% of Canada's total employed labour force, and the weekly salaries and wages are the second highest of any industry in Canada.

Table 4.8 (Appendix B), gives details of the contribution of the mineral industry to the Canadian economy: Table 4.19 (Appendix B), indicates the proportion of mineral production by provinces in 1973; Ontario produced over 1/3 of the total (36%), Quebec about 1/5 (18%), and B.C. about 15%. These three provinces produced over 2/3 of the total for that year (69%), with the other provinces sharing the remaining 31%.

(ii) Projected Requirements for Canadian Primary Minerals, 1974-2000

These projections use a combination of statistical extrapolation of trends (linear regression of logarithms of past production data), and subjective forecasts by commodity specialists.[29] The assumptions used for the projections were: continued world economic growth, no large-scale problems in the major producer/consumer nations, no marked changes in economic policies of various political/economic blocs, no major changes in patterns of population growth and no radical changes in product use or major substitutions. In addition, it is assumed that commodities are considered to depend essentially on the level of economic activity and be relatively insensitive to commodity price levels. Also, it is assumed that whatever commodities are needed would be supplied at an acceptable price.

Table 4.20 (Appendix B), outlines present reserves. At production growth rates of 4.5% to 2.5% (which for many commodities is historically low), six commodities would last roughly 20-30 years (1995-2005), provided no new reserves were developed. These are copper, lead, molybdenum, nickel, sulphur and zinc. Iron would last about 44-58 years, asbestos 80-119 years, and potash 147-239 years. These estimates of "life-times" of the minerals are only crude, but indicate roughly the time-frame within which exploration and production of minerals operate.

The majority of the production of major metals in Canada is exported and is expected to remain so (uranium is a special case). The lowest export rate was 65% of the total for copper in 2000; the highest was for nickel and molybdenum at about 95%. Lead, sulphur and zinc ran about 75-80% (Table 4.21, Appendix B). Excluding fuels, the total value of production, trade and consumption of crude minerals (in billion 1971$), are shown below:

CANADIAN PRODUCTION, TRADE AND CONSUMPTION
OF CRUDE MINERALS 1960 to 2000*
(billions of 1971 dollars)

	1960	1970	1973	2000
Imports	0.34	0.59	0.7	1.4
Domestic consumption	1.01	1.61	1.8	3.3
Exports	1.12	2.37	3.2	8.8
TOTAL CANADIAN OUTPUT	2.13	4.00	5.0	12.1
Exports as % of total output	52.6%	59.3%	64.0%	72.7%

*Fuels not included

Source: Canadian Mineral Policy in an Interdependent World, EMR, 1974.

In the aggregate sense, the total output in dollar terms is expected to triple between 1970 and 2000. Exports will make up a continuously larger proportion of the total Canadian output, rising from 64% of the total in 1970 (or almost 2/3) to approximately 73% of the total (or almost 3/4). While Canadian mineral production is increasingly geared to exports, as compared to domestic consumption, an increasing proportion of these exports in future will be in a further processed state. This means that additional increases in refining and smelting capacity will have to be created. (For example, for nickel this will represent about 83% of exports in 2000, as compared to about 60% in 1970.)

For aggregate production, the rates of growth are expected to decrease for most metals after about the mid-80's; in many cases the growth rates are expected to drop to less than half the historical (1950-1970) rates.

(iii) Supply of Canadian Minerals

An analysis of the supply side of the Canadian mineral sector indicates that, in general, Canada will be able to meet all forecasted domestic and export requirements for many minerals. This is based on the analysis of proven reserves.

An analysis of separate mineral commodities indicates that up to the year 2000:

-all nickel and iron ore requirements will be met

-copper, lead, molybdenum and zinc requirements can be met until the mid or late 1980's - after that, new deposits will have to be found and mined

-requirements for uranium oxide for domestic needs can be met into the late 1970's, but new, undiscovered deposits will have to be developed by 1980 if projected trends of local domestic and export requirements are to be met

EMR estimates that, with the exception of uranium, resources of major metals are in excess of forecast requirements in the period 1975-2000. The projections also indicate that, of the major mineral commodities (excepting nickel and iron), new sources would have to supply between 42% (molybdenum) and 80% (uranium) of expected production by 1996-2000 (see Table 4.22, Appendix B). The range would be 2-5% in the 1976-1980 period, 7-29% in 1981-85, 12-58% in 1986-1990, and 22-75% in 1991-1995 (the high percentage in all cases is for uranium).

(iv) Financial Needs

The annual capital investment and exploration expenditures are forecast to grow at an annual rate of about 3.8%, rising from about $600 million (1971 dollars) to about $1,550 million by the year 2000. By then, resources from new mines (excluding iron) will represent about 30% of the expenditures, and exploration costs about 25% of the total.

Metal exploration costs by 5-year periods to 1995 are estimated by EMR to be:

Time Interval	Total Cost (Millions of $)
1971-1975	520
1976-1980	680
1981-1985	910
1986-1990	1,200
1991-1995	1,550

The average annual capital investment and exploration expenditures to 1995 are shown in Figures 4.10, 4.11, 4.12 (Appendix C). Capital requirements for exploration will thus more than double in the last quarter-century, to about $1.6 billion. But more than two-thirds of the estimated production of major metals is intended for export. One policy option being considered is the encouragement of further processing of minerals in Canada, giving more employment to Canadians. At the same time there is the need for foreign exchange earnings that mineral exports can generate - if such earnings accrue to Canadians and are not siphoned off to multi-national and foreign corporations.

2. Urbanization

- Over 90% of the population is expected to live in urbanized areas (population 1000 and over) by 2000, assuming present trends.

- The urban population will be between 29 and 34 million; urban facilities will be needed for another 11-15 million Canadians between 1975 and 2000 (equivalent to 4 or 5 of the largest metropolitan centres of the 1970's).

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- A key question regarding urban expansion is that of "urban fringe" and land use. Calculations indicate that between about 7100 and 15,000 square miles of territory surrounding urban areas would be transformed to urbanized land over the next 25 years. Much of this would be prime agricultural land. However, expansion of smaller urban centres (non-major CMA's) consumes relatively more land. Unless active policy intervention takes place in land use, it appears preferable to encourage greater density in large urban areas.

- In considering land use and demographic trends, recreational facilities, both urban and rural, will become much more important over the next 25 years. This will further impact on the urban fringe.

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3. Economic Activity

- Reasonable economic growth rates over the next decade (to 1985) range from 4.5 to 6% per annum. Beyond 1985, an economic growth rate of 5.3% per year (1975-2000) is plausible, with the rate decreasing from 6% in the 1975-1985 decade, to about 4.5% by the year 2000.

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4. Renewable Resources

- If present trends continue, problems of food supply are likely to surface over the next 25 years. Diversion of agricultural land to urban use has tended to fall mainly on more productive farmland according to accepted agroclimatic standards. Getting maximum return out of available land may be further complicated by rising energy costs (re. farm motor-power and fertilizers) and by expanding competition for water resources (urban, recreation, power, etc)

- Fisheries, another significant food source, may be adversely affected by such factors as combined international overfishing (e.g., on the East Coast) and by the expansion of industrial and power projects in coastal land areas (e.g., Pacific salmon fishery). Protection of Canadian food resources and development of new techniques of fish management will no doubt become key issues in policy development in the next quarter-century in order to ensure continuing supplies for rising domestic and export demand.

- Expansion of the forest products industry will generate spillover effects in the costs of pollution control, forest monoculture (as "natural" forests are replanted) and in relation to alternate, or multiple, use of forested areas, such as recreation.

- Total Canadian mineral output, in constant (1971) dollar terms, may increase 2.4 times between 1973 and 2000 (i.e., from $5 billion to $12.1 billion). Over 70 % of Canadian output of non-energy minerals is projected for export. While most domestic requirements can be met for the foreseable future, in some cases this will require the exploitation of new deposits, beginning in the late 1980's. A key requirement will be to find and rapidly develop new uranium deposits by the early 1980's, if anticipated domestic needs are to be met.

5. Energy

- A continuing move to an electrically-based economy, with more hydro-dams, but also an increasing proportion of nuclear-based generation of electric power. The disposal of nuclear wastes may become a major problem.

- Unresolved uncertainties as to oil and gas supply, with estimates varying depending on rates and costs of development. Both tar sands and frontier resources are likely to come on stream in the 1980's. Eastern Canada and British Columbia are estimated to remain heavily dependent on oil imports (perhaps as part of a Canada-U.S. "swap" agreement). A supply crisis may occur in the early 1980's, prior to the coming on stream of significant new development.

- The relative significance of coal is likely to increase, both for electricity generation as well as other, transportable energy forms (by liquefaction and gasification of coal)

- By 2000, a number of new energy technologies may be in use, ranging from fusion and solar power, to increased energy use of wastes, as well as specialized applications such as wind and solar technologies.

(d) CANADA AND THE ENVIRONMENT, 1975-2000

From the analysis of alternatives in the various sectors, a number of general, as well as specific, issues of concern to future environmental policy can be inferred. These may relate not only to changes in the overall system, but also to specific policy questions.

The period 1975-2000 will be characterized by a variety of interacting crises, bottlenecks, and pressure points characteristic of periods of rapid social, economic and environmental evolution. These changes will have direct and indirect effects on the scope and direction of public policy, and on the intensity and structure of interaction among key actors, agencies and levels of decision-making. Major efforts will be required in planning and coordinating.

There will be an overall strain on public resources, particularly at the local and regional level of government. This will be measurable in terms of both dollar and manpower requirements and (more qualitatively) with reference to the capacity to make and implement policy rapidly enough to deal with emerging and perceived future problems. For a time -- from the late 1970's to the early 1990's -- there will probably be a decline in the rate of expansion of social programs. However, whether this frees adequate resources for other needs depends on (a) the degree of flexibility, within the public sector, for the transfer of resources from one area of activity to another

and (b) whether sufficient resources can be retained by the public sector for long-term development (such as environmental protection); at a time when the possible size of surpluses on current account may lead to demands to cut taxes.

- Constitutional, administrative, and structural changes are likely to be demanded in response to the emergence of new problem areas in the wake of efforts that may be made to repatriate the Canadian constitution. This may prove to be particularly urgent with reference to relations among governments vis-à-vis urban development, the general question of land use, controlling the pace of economic development, and preservation and enhancement of the environment. Whether such changes will be marginal or represent a comprehensive "new look" in intergovernmental policy-making will directly affect the efficiency and relevance of environmental and resource-management policy. Conflicts between "regional" and "national" policies will become an important issue.

- In environmental policy development, a resource-management focus could emerge, coupled with the need to secure resource supplies and manage the timing of growth in such a way as to encourage the orderly development and maintenance of urban population concentrations under optimal environmental conditions, while at the same time ensuring environmental quality in areas of resource exploitation.

- Environmental strategy will increasingly be balanced between two main lines of attack: direct and indirect. The latter consists of the interjection of environmental policy concerns into other broad areas of policy development, such as population growth, urban development, resource development, industrial strategy, etc.. Focussing of environmental policy is likely to occur around (a) expanding urban systems, internally and as they interact with their immediate surroundings; (b) environmental aspects of major resource developments; (c) the optimal management of renewable resources, primarily food; and (d) environmental aspects of major energy developments.

Specifically, inferences regarding environmental policy concerns over the period 1975-2000 can be summarized as follows:

1. Population

- The overall pressure on the physical environment and carrying capacity is dependent on the total Canadian population its age structure, regional distribution, and activity patterns. Consideration will be needed to determine an optimal population size for Canada. This will be increasingly important in view of the projected changes in the dependent population, and the effect of this on demands on public spending, including spending on environmental programs.

- Since immigration is playing an increasing role in overall population growth and age structure, the future magnitude and settlement patterns of immigrants will have to be balanced against the possible future needs for manpower in the resource development sector, especially such development may have significant environmental impacts.

2. Urbanization

- Projected future urban developments will see increasing competition for land among agriculture, industry, urban growth, infrastructure and recreational needs. The major area of competition will be in the "urban fringe".

- Related to this are questions of allocation of tax resources, transportation networks, energy use and conservation, "life styles", and long-term environmental impacts on human health.

- Since trends and projections anticipate continuing urbanization, pressures on local environments and the carrying capacities of regions will grow. Questions arise as to the desired rate of growth of the urban centers, where new urban settlement should be encouraged, and how.

- Overall, the advantages and disadvantages of alternative urban growth rates need to be considered from many aspects, environmentally and otherwise. Continuation of present urbanization trends could overload the carrying capacity of certain regions, especially the lower mainland area of B.C., and the "Golden Horseshoe" area of Ontario. Redirection of urban growth to alternate centres may generate as many problems as it solves, since the impact of rapid urban development on local environments is still imperfectly understood.

- Urban population densities need to be studied in the light of higher per capita land consumption in smaller urban centres as compared to major urban centres. Various questions of trade-offs arise here such as: (1) Should larger urban centres be encouraged? (They use less land per capita, may make control over environmental quality easier to manage in some sectors, in certain centres may provide potential efficiencies in transportation and recreational services); or, Should the approach be to encourage higher population densities in all urbanized areas? (2) Should recreational land be developed at the urban fringe, or in central core areas where higher population densities are encouraged over time? etc.

- Which modes of urban and intercity transportation should be encouraged so as to support future urbanization settlement patterns? What new technologies require implementation which will enhance the urban environment?

- Future needs for waste management will become increasingly pressing over the next 25 years. Alternative future urbanization patterns will need new processes for handling wastes, monitoring of effects on regional environments and new methods of apportioning the costs of waste control among the various public, as well as the private, sectors. Certain waste management areas (i.e. land fill and solid wastes, disposal of nuclear wastes) will become increasingly serious public concerns.

3. Economic Activity

- Irrespective of economic growth alternatives, problems of energy supply and the supply of some raw materials are expected over the next 25 years. This implies increasing pressure for resource development which raises questions of handling such developments in an environmentally acceptable manner.

- The increasing competition for capital over the next 25 years, may lead to problems of adequately funding long-term environmental programs.

- If the economy grows relatively slowly over the next decade, increasing attention being paid to purely economic matters. (i.e., unemployment, industrial growth), will probably mean increasing difficulty in developing needed initiatives for environmental concerns; thereby increasing the difficulty of funding environmental programs. This phenomenon in turn will create pressures for showing development of further environmental regulations and programs related to industrial and resource extraction activities. Probably a "stand-pat" stance would then occur in environmental matters; incremental changes in policy would probably be adequate; and indirect policy intervention into areas other than direct environmental concerns would probably be minimal.

- If the economy grows relatively rapidly, the anticipated development of the non-renewable resource and energy sector, would shift some of the environmental focus to specific geographic resource areas, especially the north and west. This raises questions of: possible new initiatives in the resource management area; the probable need to streamline environmental assessment procedures; and a possible change of focus from "environmental protection" to resource management in general. Rapid industrial growth would raise questions of the need for more stringent pollution controls, especially in urban areas. Financing of environmental initiatives would be probably become relatively easier as the needs would be more clearly perceived by the general public, and handling costs of pollution control probably more tractable.

- If the economy develops as in the mixed growth rate alternative (faster growth rates tapering off to the year 2000), sufficient resources and lead-times would probably exist to allow a reasonable level of environmental initiatives to be taken, together with policy intervention in many indirect areas of concern to the environment, as well as developing more of a resource-management focus.

4. Resources

- Over the next 25 years, it is anticipated that questions of land and water use conflict (mainly among agriculture, cities, industry, recreation) would grow, raising questions of injecting environmental concerns strongly into new areas such as urban growth and recreation, agricultural development, expansion of marginal lands (for agricultural use), use of chemicals and energy in agriculture, waste water treatment and recycling for industry and agriculture, as well as for other sectors.

- Increasing concern in longer-term environmental ramifications will arise: questions of possible long-term adverse climatic changes and its possible effects on food production; long-term effects of chemicals on biological organisms (including humans), devising adequate assessments of new chemical products introduced into the environment, etc.

- For food production, questions of conflicts will arise increasingly over fisheries resource management among users: agricultural production and urbanization; energy, fertilizers and chemicals in agriculture and environmental quality and human health.

- Over the next quarter-century, more serious questions will probably arise in forestry over such matters as increased production, forest management, wood product recycling, long-term effects of monoculture, conflicts over production and recreational usage of forests, etc.

- The expected rapid expansion of mineral production raises questions of preservation of environmental quality during all stages of mineral production and processing, adequate environmental assessment of facilities for planned developments, appropriate levels of mineral processing and smelting consistent with long-term environmental concerns, how much mineral production should be expanded to meet export demands (considering increasing pressures on the environment), paying for pollution control and abatement, etc.

5. Energy

- Irrespective of economic growth rates in other sectors, the energy supply (as a total of all forms) is expected to increase rapidly over the next 25 years. To ensure appropriate environmental considerations, general questions of: appropriate rates of overall economic growth; energy conservation; appropriate mixes of energy sources; areas to be developed for energy supplies (i.e. dams, strip-mines); encouragement of alternate technologies and supplies; etc. will have to be examined carefully.

- In order to provide for the growth of energy supplies, more particular questions will probably arise such as: the development of nuclear energy which has fewer immediate health hazards than coal-mining for power plants but which could have associated with it serious long-term environmental problems; large environmental "disasters" associated with petroleum extraction and transport and who pays for remedial action; how fossil fuel exploration, production and transport should be handled in environmentally sensitive areas, etc.

(e) ENVIRONMENTAL POLICY: 1975-2000

Since the problems of environmental management are related to the direction and pace of change in our society, future planning will need to be flexible, experimental, adaptive and anticipatory.

Certain environmental policies already in place or in various stages of development contribute to the dynamic process of managing renewable and

non-renewable resources. Perhaps the most prominent of these has been the Canada Water Act, 1970, which visualized comprehensive management of Canada's watersheds. Because of jurisdictional problems however, the Act has not been fully utilized but recent events suggest that a more complete watershed management will soon be forthcoming. The Clean Air Act has regulations and guidelines which apply to Federal financing (such as DREE grants) and which allow a degree of indirect control. In addition, Section 7 of the Act allows contaminants which have been declared risks to human health, to be controlled. The Contaminants Act, with its tie-in with the Department of Health and Welfare, allows certain control over the manufacture of products. The Arctic Waters Pollution Act (under the Department of Indian Affairs and Northern Development) provides effective policing of Arctic Waters; the Ocean Dumping Act, covering such areas as territorial waters, fishing zones, and "adjacent waters", applies to all ships, platforms, etc. in such waters, and requires dumping permits. However, the Act excludes such activities as "normal operations" of such ships, etc., outfalls, and processing of sealed mineral resources.

While environmental legislation has had some moderate degree of success, it is nevertheless true that there has been a shift in perception in the last few years. Earlier, environmental concerns were seen solely as a constraint; today the environment is seen as one factor among others, to be considered in government policy-making. Although not all segments of society are convinced of the need for specific protective mechanisms, environmental impacts can no longer be ignored in future development of Canadian society and policy formulation.

What are the future policy implications for environmental management arising out of perceived environmental concerns? Disregarding jurisdictional questions which have not been discussed in this document, some issues emerge from the document which suggest the course of future policy development either directly or indirectly. These issues can be summarized (not necessarily in terms of time spans or priority) as:

1. The overall level and structure of population growth.

2. The patterns of population distribution, regional population growth, urbanization, urban patterns, the urban environment, and environmental health.

3. The patterns of land use which optimize or maximize public expectations in terms of social needs (such as recreation) and competing demands (such as urbanization versus agriculture, etc).

4. The development and rationalization of transportation, considering such areas as: effects on population distribution, changes in social needs and impacts on them, needs for economic and resource developments, energy use and conservation, environmental quality, etc.

5. The alternative rates of economic growth as scenarios and their implications (including certain technological developments).

6. The development of renewable resources, considering the concept and limits of maximum productivity versus long-term optimum sustainable yield (central to food, fisheries and forestry management), as well as that of substitution (species and products) and social aspects.

7. The future development of Canadian mineral resources in the light of long-term security of supply, domestic processing, environmental concerns, and export revenues.

8. The future growth and development of the energy sector, considering such aspects as a rational energy mix versus over-dependence on any single energy technology, competing energy uses, associated environmental impacts, energy conservation, etc.

9. The evaluation of the long-term effects of dynamic natural environmental patterns and cycles (such as changing climatic patterns and their effects on food production, urban needs, population distribution; "natural contaminants" in the environment; etc), as compared to man-made impacts (such as: man-made contaminants, environmental health, effects on physical environment of such things as freons, etc)

In addition, the direction and pace of future Canadian development will require a change in focus from sectoral environmental management to total resource management. New structures and policy instruments need to be devised so that environmental concerns are integrated in all areas of policy planning. A shift to longer term, integrated planning, as compared to crisis management or incremental approaches will help to ensure that the future growth of Canada preserves and enhances our life-support systems.

With a view to the future, governmental policy planning for resource management should be considered within a framework of regional environmental needs and the "boundaries" of "natural" ecosystems; and the associated jurisdictional challenges must be incorporated into the required formulae for future environmental problem solving.

APPENDICES

APPENDIX A - REFERENCES

Population

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4. Renewable Resources

- If present trends continue, problems of food supply are likely to surface over the next 25 years. Diversion of agricultural land to urban use has tended to fall mainly on more productive farmland according to accepted agroclimatic standards. Getting maximum return out of available land may be further complicated by rising energy costs (re. farm motor-power and fertilizers) and by expanding competition for water resources (urban, recreation, power, etc)

- Fisheries, another significant food source, may be adversely affected by such factors as combined international overfishing (e.g., on the East Coast) and by the expansion of industrial and power projects in coastal land areas (e.g., Pacific salmon fishery). Protection of Canadian food resources and development of new techniques of fish management will no doubt become key issues in policy development in the next quarter-century in order to ensure continuing supplies for rising domestic and export demand.

- Expansion of the forest products industry will generate spillover effects in the costs of pollution control, forest monoculture (as "natural" forests are replanted) and in relation to alternate, or multiple, use of forested areas, such as recreation.

- Total Canadian mineral output, in constant (1971) dollar terms, may increase 2.4 times between 1973 and 2000 (i.e., from $5 billion to $12.1 billion). Over 70 % of Canadian output of non-energy minerals is projected for export. While most domestic requirements can be met for the foreseable future, in some cases this will require the exploitation of new deposits, beginning in the late 1980's. A key requirement will be to find and rapidly develop new uranium deposits by the early 1980's, if anticipated domestic needs are to be met.

5. Energy

- A continuing move to an electrically-based economy, with more hydro-dams, but also an increasing proportion of nuclear-based generation of electric power. The disposal of nuclear wastes may become a major problem.

- Unresolved uncertainties as to oil and gas supply, with estimates varying depending on rates and costs of development. Both tar sands and frontier resources are likely to come on stream in the 1980's. Eastern Canada and British Columbia are estimated to remain heavily dependent on oil imports (perhaps as part of a Canada-U.S. "swap" agreement). A supply crisis may occur in the early 1980's, prior to the coming on stream of significant new development.

- The relative significance of coal is likely to increase, both for electricity generation as well as other, transportable energy forms (by liquefaction and gasification of coal)

- By 2000, a number of new energy technologies may be in use, ranging from fusion and solar power, to increased energy use of wastes, as well as specialized applications such as wind and solar technologies.

(d) CANADA AND THE ENVIRONMENT, 1975-2000

From the analysis of alternatives in the various sectors, a number of general, as well as specific, issues of concern to future environmental policy can be inferred. These may relate not only to changes in the overall system, but also to specific policy questions.

The period 1975-2000 will be characterized by a variety of interacting crises, bottlenecks, and pressure points characteristic of periods of rapid social, economic and environmental evolution. These changes will have direct and indirect effects on the scope and direction of public policy, and on the intensity and structure of interaction among key actors, agencies and levels of decision-making. Major efforts will be required in planning and coordinating.

There will be an overall strain on public resources, particularly at the local and regional level of government. This will be measurable in terms of both dollar and manpower requirements and (more qualitatively) with reference to the capacity to make and implement policy rapidly enough to deal with emerging and perceived future problems. For a time -- from the late 1970's to the early 1990's -- there will probably be a decline in the rate of expansion of social programs. However, whether this frees adequate resources for other needs depends on (a) the degree of flexibility, within the public sector, for the transfer of resources from one area of activity to another

and (b) whether sufficient resources can be retained by the public sector for long-term development (such as environmental protection); at a time when the possible size of surpluses on current account may lead to demands to cut taxes.

- Constitutional, administrative, and structural changes are likely to be demanded in response to the emergence of new problem areas in the wake of efforts that may be made to repatriate the Canadian constitution. This may prove to be particularly urgent with reference to relations among governments vis-à-vis urban development, the general question of land use, controlling the pace of economic development, and preservation and enhancement of the environment. Whether such changes will be marginal or represent a comprehensive "new look" in intergovernmental policy-making will directly affect the efficiency and relevance of environmental and resource-management policy. Conflicts between "regional" and "national" policies will become an important issue.

- In environmental policy development, a resource-management focus could emerge, coupled with the need to secure resource supplies and manage the timing of growth in such a way as to encourage the orderly development and maintenance of urban population concentrations under optimal environmental conditions, while at the same time ensuring environmental quality in areas of resource exploitation.

- Environmental strategy will increasingly be balanced between two main lines of attack: direct and indirect. The latter consists of the interjection of environmental policy concerns into other broad areas of policy development, such as population growth, urban development, resource development, industrial strategy, etc.. Focussing of environmental policy is likely to occur around (a) expanding urban systems, internally and as they interact with their immediate surroundings; (b) environmental aspects of major resource developments; (c) the optimal management of renewable resources, primarily food; and (d) environmental aspects of major energy developments.

Specifically, inferences regarding environmental policy concerns over the period 1975-2000 can be summarized as follows:

1. Population

- The overall pressure on the physical environment and carrying capacity is dependent on the total Canadian population its age structure, regional distribution, and activity patterns. Consideration will be needed to determine an optimal population size for Canada. This will be increasingly important in view of the projected changes in the dependent population, and the effect of this on demands on public spending, including spending on environmental programs.

- Since immigration is playing an increasing role in overall population growth and age structure, the future magnitude and settlement patterns of immigrants will have to be balanced against the possible future needs for manpower in the resource development sector, especially such development may have significant environmental impacts.

2. Urbanization

- Projected future urban developments will see increasing competition for land among agriculture, industry, urban growth, infrastructure and recreational needs. The major area of competition will be in the "urban fringe".

- Related to this are questions of allocation of tax resources, transportation networks, energy use and conservation, "life styles", and long-term environmental impacts on human health.

- Since trends and projections anticipate continuing urbanization, pressures on local environments and the carrying capacities of regions will grow. Questions arise as to the desired rate of growth of the urban centers, where new urban settlement should be encouraged, and how.

- Overall, the advantages and disadvantages of alternative urban growth rates need to be considered from many aspects, environmentally and otherwise. Continuation of present urbanization trends could overload the carrying capacity of certain regions, especially the lower mainland area of B.C., and the "Golden Horseshoe" area of Ontario. Redirection of urban growth to alternate centres may generate as many problems as it solves, since the impact of rapid urban development on local environments is still imperfectly understood.

- Urban population densities need to be studied in the light of higher per capita land consumption in smaller urban centres as compared to major urban centres. Various questions of trade-offs arise here such as: (1) Should larger urban centres be encouraged? (They use less land per capita, may make control over environmental quality easier to manage in some sectors, in certain centres may provide potential efficiencies in transportation and recreational services); or, Should the approach be to encourage higher population densities in all urbanized areas? (2) Should recreational land be developed at the urban fringe, or in central core areas where higher population densities are encouraged over time? etc.

- Which modes of urban and intercity transportation should be encouraged so as to support future urbanization settlement patterns? What new technologies require implementation which will enhance the urban environment?

- Future needs for waste management will become increasingly pressing over the next 25 years. Alternative future urbanization patterns will need new processes for handling wastes, monitoring of effects on regional environments and new methods of apportioning the costs of waste control among the various public, as well as the private, sectors. Certain waste management areas (i.e. land fill and solid wastes, disposal of nuclear wastes) will become increasingly serious public concerns.

3. Economic Activity

- Irrespective of economic growth alternatives, problems of energy supply and the supply of some raw materials are expected over the next 25 years. This implies increasing pressure for resource development which raises questions of handling such developments in an environmentally acceptable manner.

- The increasing competition for capital over the next 25 years, may lead to problems of adequately funding long-term environmental programs.

- If the economy grows relatively slowly over the next decade, increasing attention being paid to purely economic matters. (i.e., unemployment, industrial growth), will probably mean increasing difficulty in developing needed initiatives for environmental concerns; thereby increasing the difficulty of funding environmental programs. This phenomenon in turn will create pressures for showing development of further environmental regulations and programs related to industrial and resource extraction activities. Probably a "stand-pat" stance would then occur in environmental matters; incremental changes in policy would probably be adequate; and indirect policy intervention into areas other than direct environmental concerns would probably be minimal.

- If the economy grows relatively rapidly, the anticipated development of the non-renewable resource and energy sector, would shift some of the environmental focus to specific geographic resource areas, especially the north and west. This raises questions of: possible new initiatives in the resource management area; the probable need to streamline environmental assessment procedures; and a possible change of focus from "environmental protection" to resource management in general. Rapid industrial growth would raise questions of the need for more stringent pollution controls, especially in urban areas. Financing of environmental initiatives would be probably become relatively easier as the needs would be more clearly perceived by the general public, and handling costs of pollution control probably more tractable.

- If the economy develops as in the mixed growth rate alternative (faster growth rates tapering off to the year 2000), sufficient resources and lead-times would probably exist to allow a reasonable level of environmental initiatives to be taken, together with policy intervention in many indirect areas of concern to the environment, as well as developing more of a resource-management focus.

4. Resources

- Over the next 25 years, it is anticipated that questions of land and water use conflict (mainly among agriculture, cities, industry, recreation) would grow, raising questions of injecting environmental concerns strongly into new areas such as urban growth and recreation, agricultural development, expansion of marginal lands (for agricultural use), use of chemicals and energy in agriculture, waste water treatment and recycling for industry and agriculture, as well as for other sectors.

- Increasing concern in longer-term environmental ramifications will arise: questions of possible long-term adverse climatic changes and its possible effects on food production; long-term effects of chemicals on biological organisms (including humans), devising adequate assessments of new chemical products introduced into the environment, etc.

- For food production, questions of conflicts will arise increasingly over fisheries resource management among users: agricultural production and urbanization; energy, fertilizers and chemicals in agriculture and environmental quality and human health.

- Over the next quarter-century, more serious questions will probably arise in forestry over such matters as increased production, forest management, wood product recycling, long-term effects of monoculture, conflicts over production and recreational usage of forests, etc.

- The expected rapid expansion of mineral production raises questions of preservation of environmental quality during all stages of mineral production and processing, adequate environmental assessment of facilities for planned developments, appropriate levels of mineral processing and smelting consistent with long-term environmental concerns, how much mineral production should be expanded to meet export demands (considering increasing pressures on the environment), paying for pollution control and abatement, etc.

5. Energy

- Irrespective of economic growth rates in other sectors, the energy supply (as a total of all forms) is expected to increase rapidly over the next 25 years. To ensure appropriate environmental considerations, general questions of: appropriate rates of overall economic growth; energy conservation; appropriate mixes of energy sources; areas to be developed for energy supplies (i.e. dams, strip-mines); encouragement of alternate technologies and supplies; etc. will have to be examined carefully.

- In order to provide for the growth of energy supplies, more particular questions will probably arise such as: the development of nuclear energy which has fewer immediate health hazards than coal-mining for power plants but which could have associated with it serious long-term environmental problems; large environmental "disasters" associated with petroleum extraction and transport and who pays for remedial action; how fossil fuel exploration, production and transport should be handled in environmentally sensitive areas, etc.

(e) ENVIRONMENTAL POLICY: 1975-2000

Since the problems of environmental management are related to the direction and pace of change in our society, future planning will need to be flexible, experimental, adaptive and anticipatory.

Certain environmental policies already in place or in various stages of development contribute to the dynamic process of managing renewable and

non-renewable resources. Perhaps the most prominent of these has been the Canada Water Act, 1970, which visualized comprehensive management of Canada's watersheds. Because of jurisdictional problems however, the Act has not been fully utilized but recent events suggest that a more complete watershed management will soon be forthcoming. The Clean Air Act has regulations and guidelines which apply to Federal financing (such as DREE grants) and which allow a degree of indirect control. In addition, Section 7 of the Act allows contaminants which have been declared risks to human health, to be controlled. The Contaminants Act, with its tie-in with the Department of Health and Welfare, allows certain control over the manufacture of products. The Arctic Waters Pollution Act (under the Department of Indian Affairs and Northern Development) provides effective policing of Arctic Waters; the Ocean Dumping Act, covering such areas as territorial waters, fishing zones, and "adjacent waters", applies to all ships, platforms, etc. in such waters, and requires dumping permits. However, the Act excludes such activities as "normal operations" of such ships, etc., outfalls, and processing of sealed mineral resources.

While environmental legislation has had some moderate degree of success, it is nevertheless true that there has been a shift in perception in the last few years. Earlier, environmental concerns were seen solely as a constraint; today the environment is seen as one factor among others, to be considered in government policy-making. Although not all segments of society are convinced of the need for specific protective mechanisms, environmental impacts can no longer be ignored in future development of Canadian society and policy formulation.

What are the future policy implications for environmental management arising out of perceived environmental concerns? Disregarding jurisdictional questions which have not been discussed in this document, some issues emerge from the document which suggest the course of future policy development either directly or indirectly. These issues can be summarized (not necessarily in terms of time spans or priority) as:

1. The overall level and structure of population growth.

2. The patterns of population distribution, regional population growth, urbanization, urban patterns, the urban environment, and environmental health.

3. The patterns of land use which optimize or maximize public expectations in terms of social needs (such as recreation) and competing demands (such as urbanization versus agriculture, etc).

4. The development and rationalization of transportation, considering such areas as: effects on population distribution, changes in social needs and impacts on them, needs for economic and resource developments, energy use and conservation, environmental quality, etc.

5. The alternative rates of economic growth as scenarios and their implications (including certain technological developments).

6. The development of renewable resources, considering the concept and limits of maximum productivity versus long-term optimum sustainable yield (central to food, fisheries and forestry management), as well as that of substitution (species and products) and social aspects.

7. The future development of Canadian mineral resources in the light of long-term security of supply, domestic processing, environmental concerns, and export revenues.

8. The future growth and development of the energy sector, considering such aspects as a rational energy mix versus over-dependence on any single energy technology, competing energy uses, associated environmental impacts, energy conservation, etc.

9. The evaluation of the long-term effects of dynamic natural environmental patterns and cycles (such as changing climatic patterns and their effects on food production, urban needs, population distribution; "natural contaminants" in the environment; etc), as compared to man-made impacts (such as: man-made contaminants, environmental health, effects on physical environment of such things as freons, etc)

In addition, the direction and pace of future Canadian development will require a change in focus from sectoral environmental management to total resource management. New structures and policy instruments need to be devised so that environmental concerns are integrated in all areas of policy planning. A shift to longer term, integrated planning, as compared to crisis management or incremental approaches will help to ensure that the future growth of Canada preserves and enhances our life-support systems.

With a view to the future, governmental policy planning for resource management should be considered within a framework of regional environmental needs and the "boundaries" of "natural" ecosystems; and the associated jurisdictional challenges must be incorporated into the required formulae for future environmental problem solving.

APPENDICES

APPENDIX A - REFERENCES

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APPENDIX B - TABLES

*Note - page numbers in brackets refer to the page that tables are found in the text. Other tables appear as listed in Appendix B.

Table 1.6b: POSSIBLE EFFECTS OF THE CHANGING AGE STRUCTURE OF CANADA, 1972-1992

Economic Activity

1972-82

- strong demand now for capital for housing, heavy durable goods, etc., as 25-34 age group begins family formation
- increased current urban expansion (housing, transport infrastructure) to strain environmental amenities (land, water, air, recreation, etc.)
- on supply side, need to stimulate savings, investment and production of goods to meet demands

1982-92

- after the age of 50, family expenditures begin to decline (by 1990 leading-edge of baby-boom in this age group)
- continuation of poverty for increasing aged population may change as this group become more politically active
- older and retired people are major supporters and stimulators of tourism (to visit or vacation near friends or relatives)

General Outlook

- shorter time horizons of aged may reduce risk-taking and entreprenurial efforts
- more older consumers, less disposed to modify consumption patterns
- educational attainment levels and aspirations will continue to rise, affecting labour force composition, markets and leisure activities[15]
- housing for elderly increasingly inadequate (e.g., no provision for handicapped or wheelchairs)
- transportation needs of an aging population and changing lifestyles must be redesigned (e.g., transport, not just to move people to work)

Source: Auerbach, Lewis, Implications of the Changing Age Structure of the Canadian Population, Science Council of Canada, Study on Population and Technology, November 1974, p. 2.

Table 2.1: POPULATION (000's) IN THE 22 CMA's FOR 1971 AND 2001 OF THE TWO URBANIZATION ALTERNATIVES

CMA	1971	2001 CONTINUATION OF TREND Population	(Pop.2001)/(Pop.1971)	2001 1971 REGIONAL PROPORTIONS Population	(Pop.2001)/(Pop.1971)
(a) Major CMA's					
Montreal	2,743	3,355	1.22	3,703	1.35
Toronto	2,628	3,689	1.40	3,048	1.16
Vancouver	1,082	2,102	1.94	1,255	1.16
(b) Other CMA's					
Calgary	403	956	2.37	544	1.35
Chicoutimi-Jonquière	134	135	1.01	281	2.10
Edmonton	496	899	1.81	670	1.35
Halifax-Dartmouth	223	285	1.28	468	2.10
Hamilton	499	637	1.27	674	1.35
Kitchener	227	380	1.67	306	1.35
London	286	454	1.58	386	1.35
Ottawa-Hull	602	1,031	1.71	873	1.35
Quebec	481	746	1.55	1,010	2.10
Regina	141	142	1.01	296	2.10
St. Catharines	303	393	1.30	409	1.35
St. John's	132	163	1.24	277	2.10
Saint John	107	101	0.95	225	2.10
Saskatoon	126	153	1.21	265	2.10
Sudbury	155	290	1.86	209	1.35
Thunder Bay	112	110	0.99	151	1.35
Victoria	196	351	1.79	265	1.35
Windsor	259	361	1.39	350	1.35
Winnipeg	540	637	1.18	1,134	2.10
CMA's population (Total, % of national population)	11,875 55.1%	17,370 58.3%	1.46 (av)	16,739 56.1%	1.41 (av)
Major CMA's population (total, % of total CMA pop)	6,453 54.3%	9,146 52.7%	1.42 (av)	8,006 47.8%	1.24 (av)
Major CMA's population (total, % of national pop)	6,453 29.9%	9,146 30.7%		8,006 26.9%	

Source: Ministry of State for Urban Affairs, Ottawa, 1974, 1975

Table 2.2; DISTRIBUTION OF POPULATION (000's) BY PROVINCE IN 1971 AND 2001; CONTINUATION OF TREND AND PRESERVATION OF 1971 PROVINCIAL PROPORTIONS ALTERNATIVES

	1971	2001	
	ACTUAL	TREND ALTERNATIVE	1971 PROPORTIONS ALTERNATIVE
Canada	21,568(100)*	29,795(100)	29,795(100)
Newfoundland	522(2.4)	671(2.3)	721(2.4)
P.E.I.	112(0.5)	120(0.4)	155(0.5)
Nova Scotia	788(3.7)	834(2.3)	1,089(3.7)
New Brunswick	635(2.9)	665(2.3)	877(2.9)
Quebec	6,028(28.9)	6,380(21.4)	8,327(28.9)
Ontario	7,703(35.7)	12,771(42.8)	10,642(35.7)
Manitoba	988(4.6)	1,049(3.5)	1,365(4.6)
Saskatchewan	936(4.3)	309(1.3)	1,279(4.3)
Alberta	1,628(7.5)	2,628(8.8)	2,249(7.5)
British Columbia	2,185(10.1)	4,187(14.0)	3,018(10.1)
Yukon	18(0.1)	41(0.1)	25(0.1)
N.W.T.	35(0.2)	96(0.3)	48(0.2)

Source: Ministry of State for Urban Affairs, Ottawa, 1974.

*Note: Percent of total in parenthesis.

Table 2.3: TOTAL OF 22 CMA's POPULATION BY PROVINCE ('000's) AND THEIR PROPORTION OF PROVINCIAL POPULATIONS

	1971	2001	
	ACTUAL	TREND ALTERNATIVE	1971 PROPORTIONS CASE
Canada	11,875(55.1)*	17,370(58.3)	16,739(56.1)
Newfoundland	132(25.3)	163(24.3)	277(38.4)
P.E.I.	--	--	--
Nova Scotia	223(28.3)	285(34.2)	468(43.0)
New Brunswick	107(16.9)	101(15.2)	225(25.7)
Quebec	3,358(55.7)	4,236(46.2)	4,994(60.0)
Ontario	5,071(65.8)	7,345(57.5)	6,346(59.6)
Manitoba	540(54.7)	637(60.7)	1,134(83.0)
Saskatchewan	267(28.8)	295(95.5)	561(43.9)
Alberta	899(55.2)	1,855(70.6)	1,214(54.0)
British Columbia	1,278(58.5)	2,453(58.6)	1,520(50.4)
Yukon	--	--	--
N.W.T.	--	--	--

*Note: Percent of total in parentheses.

Table 2.6: PERSONAL FACTORS AFFECTING AVAILABILITY OF LEISURE TIME OF CANADIANS

Part A TOTAL LENGTH OF WORKING LIFE

Year	1976	1980	1990	2000
Average life expectancy (years)				
Males	69.5	70.9	73.8	76.7
Females	76.9	77.4	81.5	84.5
Average age of entry to labour force (est.)	21	21	22	23
Average age of retirement (est.)	64	60	57	54
Average potential number of years in the labour force	43	39	35	31
Average potential number of years spent out of the labour force				
Males	26	32	39	46
Females	34	38	47	54

Part B DISTRIBUTION OF WORK AND POTENTIAL* LEISURE TIME DURING THE YEAR

Year	1976	1980	1990	2000
Length of working day(hrs.)	7.5	6.7	5.6	5.0
Length of working weeks(hrs.)	38	32	29	25
Annual vacation(weeks)	3.0	4.0	5.0	7.0
Total hours worked per year	1860	1540	1360	1120
Per cent of available year spent on:				
Work	35%	29%	26	21%
Discretionary	65%	71%	74%	79%

*Note: Excludes time spent on sleeping, eating and personal maintenance (estimated at about 40% of the total year).

Table 2.7 PARK AREAS IN CANADA IN 1972 (SQUARE MILES)

	Thousands Population*	% of Population	Area National Parks	Area Provincial Parks	Total Area	% of Total Area
Newfoundland	532	2.4	846	107	953	0.6
Prince Edward Island	113	0.5	7	4	11	-
Nova Scotia	794	3.6	513	19	532	0.3
New Brunswick	642	2.9	165	83	248	0.2
Quebec	6,059	27.8	303	75,000	75,303	50.5
Ontario	7,825	35.9	737	5,928	6,665	4.5
Manitoba	992	4.5	1,148	3,385	4,533	3.0
Saskatchewan	916	4.2	1,496	1,822	3,318	2.2
Alberta	1,655	7.6	20,882	2,357	23,239	15.6
British Columbia	2,247	10.3	1,716	10,664	12,380	8.3
Yukon/NWT	55	0.3	22,040	-	22,040	14.8
Total	21,830	100%	49,853	99,369	149,222	100%

Source: Canada Year Book, 1971, 1972, 1973.

* Note: 1972 population estimated; Canada Year Book, 1973, Table 5.6.

Table 2.8: PASSENGER OUTPUT PROJECTIONS
(billions of passenger-miles)

	Actual 1970	%	1980	%	1990	%	2000	%
Intercity								
Automobile	66.00	51.1	110.69	49.9	126.95	42.9	143.42	37.0
Air	5.74	4.4	14.06	6.3	34.78	11.8	76.04	19.6
Bus	3.54	2.7	5.69	2.6	8.43	2.8	10.90	2.8
Rail*	2.27	1.8	2.00	0.9	2.00	0.7	2.00	0.5
Total	77.55	60.0	132.44	59.7	172.16	58.2	232.36	59.9
Urban								
Automobile	47.04	36.4	83.51	37.6	114.86	38.8	143.42	37.0
Public transit	4.63	3.6	6.04	2.7	8.71	3.0	11.89	3.1
Total	51.67	40.0	89.55	40.3	123.57	41.8	155.31	40.1
GRAND TOTAL	129.22	100.0	221.99	100.0	295.73	100.0	387.67	100.0

Source: "The Impact of Energy Futures on the Canadian Transportation Sector," Transportation Development Agency, p. 154:

Based on Systems Research Group, Canada 2000 forecasts, Department of Energy, Mines and Resources, Energy Policy for Canada, and Central Mortgage and Housing Corporation, Urban Canada.

Assumption that Government policy regarding rail passenger service will work so as to maintain overall rail passenger output at current levels.

Table 2.9: ENERGY AND PRICE DATA FOR PASSENGER TRANSPORT

MODE	ENERGY BTU/passenger-mile	PRICE Cents/passenger-mile
INTERCITY *		
Bus	1600	3.6
Railroad	2900	4.0
Automobile	3400	4.0
Airplane	8400	6.0
URBAN **		
Automobile	8100	9.6
Mass Transit	3800	8.3

* Load factors (percentage of transport capacity utilized) for intercity travel are about: bus, 45%; railroad, 35%; automobile, 48%; and airplane, 50%.

** Load Factors for urban travel are about: automobile, 28%; and mass transit, 20%.

Source: "Efficiency of Energy Use in the United States," Eric Hirst, Science, Vol. 179, p. 1300.

Table 2.10: FREIGHT TON-MILES IN CANADA, 1938 TO 1970

Year	Rail	Road	Water	Air	Pipeline		Grand Total
					Oil	Gas	
1938	26.84(51)	1.52(3)	24.27(46)	*	*	*	52.62(100)
1940	37.90(61)	1.85(3)	22.51(36)	*	*	*	62.25(100)
1942	56.15(71)	2.42(3)	20.57(26)	*	*	*	79.15(100)
1944	65.93(74)	2.67(3)	20.31(23)	*	*	*	88.91(100)
1946	55.31(72)	3.50(4)	18.37(24)	*	*	*	77.18(100)
1948	59.08(68)	5.19(5)	23.20(27)	*	*	*	87.48(100)
1950	55.54(61)	7.60(8)	27.02(30)	*	.60(1)	*	90.77(100)
1952	68.43(61)	8.90(8)	30.87(27)	.02(*)	4.69(4)	*	112.90(100)
1954	57.55(54)	10.01(9)	29.62(28)	.02(*)	9.06(9)	*	106.26(100)
1956	78.82(54)	10.61(7)	39.41(27)	.04(*)	16.19(12)	*	145.07(100)
1958	66.34(51)	14.08(11)	34.26(26)	.04(*)	14.32(11)	1.63(1)	130.69(100)
1960	65.45(47)	13.84(10)	36.87(26)	.04(*)	17.23(11)	6.41(5)	139.84(100)
1962	67.94(41)	16.58(11)	42.95(26)	.05(*)	24.30(16	11.71(6)	163.53(100)
1964	85.03(41)	17.47(9)	59.19(29)	.06(*)	28.03(14)	15.31(7)	205.09(100)
1966	95.10(41)	18.95(9)	64.41(28)	.09(*)	33.07(14)	17.94(8)	229.56(100)
1968	96.09(38)	21.17(9)	58.86(26)	.10(*)	40.89(16)	21.30(9)	238.41(100)
1970	110.10(31)	56.92(16)	96.46(28)	.29(.1)	55.55(16)	30.79(9)	350.11(100)

* Less than smallest units used

Source: Statistics Canada No. 50-001 Issue 2, March 1970
-updated from various Statistics Canada publications

1970 figures were obtained from "The Impact of Energy Factors on the Canadian Transportation Sector" TDA

Table 2.11: FREIGHT OUTPUT, 1970

			(billion ton-miles)	%
Intercity Package	- Truck		37.01	10.5
	- Rail		67.21	19.2
	- Air		0.29	0.1
		Total	104.51	29.8
Intercity Bulk	- Rail		42.89	12.2
	- Water		96.46	27.5
	- Oil Pipeline		55.55	15.9
	- Gas Pipeline		30.79	8.9
		Total	225.69	64.5
Urban	- Truck		19.91	5.7
TOTAL			350.11	100.0
Modal breakdown:	Rail		110.10	31.4
	Water		96.46	27.6
	Truck		56.92	16.2
	Oil Pipeline		55.55	15.9
	Gas Pipeline		30.79	8.8
	Air		0.29	0.1
				100.0

SOURCES: "The Impact of Energy Futures on the Canadian Transportation Sector" Transportation Development Agency, p. 151.

Based on DBS estimates for 1967 in 50-001 (March, 1970) updated to 1970 by various methods and adjusted upwards for water to include private carriers and for truck to compensate for underestimates revealed in 53-224.

Table 2.12: FREIGHT OUTPUT PROJECTIONS BY MARKET
(BILLIONS OF TON-MILES)

	Actual 1970	%	1980	%	1990	%	2000	%
Intercity - truck	37.01	10.5	74.58	13.1	139.15	14.8	231.54	14.9
- air	0.29	0.1	0.67	0.1	1.67	0.2	4.12	0.3
- rail	110.10	31.4	171.36	30.1	255.44	27.2	408.74	26.3
- water	96.46	27.5	134.22	23.6	211.75	22.6	353.80	22.8
- oil pipeline	55.55	15.9	101.32	17.8	177.61	19.0	304.02	19.6
- gas pipeline	30.79	8.9	61.77	10.8	114.15	12.2	199.80	12.8
- total	225.69	64.5	381.40	67.0	627.42	67.0	1,067.65	68.7
Urban - truck	19.91	5.7	25.97	4.5	37.45	4.0	51.12	3.3
Total	350.11	100.0	569.89	100.0	937.22	100.0	1,553.14	100.0

Source: "The Impacts of Energy Futures on the Canadian Transportation Sector", Transportation Development Agency, p. 153.

Based on Systems Research Group, Canada 2000 forecasts and Department of Energy, Mines and Resources, An Energy Policy for Canada.

Table 2.14: WASTE QUANTITIES IN CANADA AND THE UNITED STATES*

Type of Waste	UNITED STATES Mill. T./Yr.	UNITED STATES Lb./Cap./Day	CANADA Mill.T./Yr.	CANADA Lb./Cap./Day	%
Household, Commercial and Municipal	250	6.4	17	4.3	4.1
Industrial	110	2.8	11	2.8	
Agricultural (excluding animals)	550	14.0	55	14.0	30.5
Agricultural (animals)	1,500	38.0	150	38.0	
Mineral	1,100	28.0	440	111.3	65.4
Total	3,510	89.2	673	170.4	100.0

* Derived from Thurlow and Associates Report; Seventh Symposium, Royal Society of Canada, April, 1974; see Clark, R.H., "Solid Wastes and Resource Recovery in Canada."

Table 2.15: PROPORTION OF RECOVERABLE MATERIAL RESOURCES CURRENTLY BEING RECYCLED IN THE UNITED STATES (1971)

Material	Short Tons available for recycling	Short Tons Recycled	Per cent Recycled
Aluminum	2,215,000	1,056,000	48
Copper	2,456,000	1,489,000	61
Lead	1,406,000	585,000	42
Zinc	1,271,000	182,000	14
Nickel	106,000	42,100	40
Steel	141,000,000	36,700,000	26
Stainless Steel	429,000	378,000	88
Precious Metals (troy ounces)	105,000,000	79,000,000	75
Paper	46,800,000	11,400,000	19
Textiles	4,700,000	800,000	17

Source: Ex Parte 281 Environmental Impact Statement, ICC.

Table 2.16: PROJECTED URBAN EXPENDITURES ON SOLID WASTE TREATMENT[a]

(millions of constant dollars)

	Annual Operations & Maintenance[b]				Incineration[c]		
	Land Fill or Incineration						
	Lb./Capita	% Treated	Low	High	Annual Capital Investment	Annual O & M	Total
1971	4.6	25.0	241.8	246.1	14.0	23.0	37.0
1981	5.6	50.0	344.7	368.8	27.2	69.0	96.2
2001	7.6	100.0	623.5	764.0	72.0	287.0	359.0

[a] Compiled from information provided by Systems Research Group.

[b] Includes both collection and site costs. Projections are the same regardless of method of treatment, since both employ the same method of collection and this absorbs 75 to 90 per cent of the expenditures. Does not include capital.

[c] Site costs only. Does not include expenditures on collection. Assumes high population projection and increasing per capita production of waste.

Source: J.W. MacNeill, (1971), Environmental Management, p. 101.

Table 2.17: ENERGY CONTENT OF CONSTITUENTS OF MUNICIPAL AND COMMERCIAL REFUSE

Constituent	Combustion Energy BTU/lb	Process* Energy BTU/lb	Total Energy BTU/lb	Total Energy BTU per lb Waste
Paper	6,100	17,000	23,100	12,400
Food wastes	3,500	3,500(?)	7,000	1,700
Metal	-	21,800	21,800	1,200
Glass	-	8,724	8,724	500
Wood	5,500	2,400	7,900	400
Plastics, etc.	15,000	27,000	42,000	1,400
TOTAL	-	-	-	17,600

*Estimated from reported process data and data

Table 2.19: CAPITAL AND OPERATING COSTS OF WATER TREATMENT FOR URBAN AREAS

A. Costs, 1970-1974

Year	Capital Costs ($million)	Operating Costs* ($million)	Total ($million)
1970	170.3	85.5	255.8
1971	255.4	86.3	341.7
1972	260.4	87.3	347.7
1973	345.6	88.4	434.0
1974	224.3	89.6	331.9

B. Projected Costs for 1999-2000

Province	Capital Costs ($ million)	Operating Costs ($ million)	Total ($ million)
Newfoundland	41.4	0.7	42.1
Nova Scotia	67.3	2.2	69.5
New Brunswick	55.9	1.9	57.8
Prince Edward Island	6.7	0.2	6.9
Quebec	388.8	11.6	400.4
Ontario	644.7	22.8	667.5
Manitoba	59.5	2.3	61.8
Saskatchewan	61.6	2.5	64.1
Alberta	118.7	4.5	123.2
British Columbia	157.6	4.4	162.0
Total	1,602.2	53.1	1,656.3

Source: Seaden, G. (1970): Municipal Sewage Disposal - Trends, Problems, Solutions, Internal Report, CMHC

Note: Estimate based on a cost of $4.00 per capita

Table 2.20: EMISSIONS IN THOUSANDS OF TONS DUE TO FOSSIL FUELS[a] 1966-1990

Source	Aldehydes	Carbon Monoxide	Hydro-Carbons	Other Organics	Oxides of Nitrogen	Oxides of Sulphur	Parti-culates	Total Without CO_2	Carbon Dioxide	Total With CO_2
1966										
Residential & Commercial	5.3	75.3	20.6	–	140.2	973.9	182.6	1,397.9	82,664.9	84,062.8
Industrial	2.6	351.7	72.2	.7	166.2	1,029.0	723.9	2,346.3	68,725.0	71,071.3
Transportation	16.9	8,460.5	1,598.8	25.3	457.1	199.8	88.7	10,847.1	71,702.9	82,550.0
Electricity Generation	.1	1.7	1.2	.1	104.5	332.6	395.6[b]	835.8	20,790.0	21,625.8
Totals	24.9	8,889.2	1,692.8	26.1	868.0	2,535.3	1,390.8	15,427.1	243,882.8	259,390.9
Percentage Total Without CO_2	1.6	57.8	11.0	1.7	5.6	16.6	9.0			
1975										
Residential & Commercial	5.9	32.0	12.6	–	159.0	989.9	101.3	1,300.7	100,999.2	102,299.9
Industrial	3.9	332.8	69.2	1.4	231.5	1,154.1	696.9	2,489.8	98,393.6	100,883.4
Transportation	25.2	12,446.0	2,352.6	37.2	683.7	346.9	134.5	16,025.9	109,293.5	125,319.4
Electricity Generation	.2	4.8	2.9	.1	267.4	803.5	1,162.5[b]	2,241.4	49,320.0	51,561.4
Totals	35.2	12,815.6	2,437.3	38.7	1,341.6	3,294.4	2,095.2	22,057.8	358,006.3	380,064.1
1990										
Residential & Commercial	7.1	7.3	8.8	–	205.7	1,122.8	62.3	1,414.0	142,888.2	144,302.2
Industrial	7.2	377.5	80.2	3.0	400.9	1,650.1	812.9	3,331.8	173,392.3	176,724.1
Transportation	45.1	20,853.8	3,961.4	55.7	1,237.4	922.4	259.8	27,345.6	208,930.9	236,276.5
Electricity Generation	.6	11.2	8.0	.4	710.5	1,403.5	3,195.0[b]	5,329.2	127,500.0	132,829.2
Totals	60.0	21,249.8	4,058.4	69.1	2,554.5	5,098.8	4,330.0	37,420.6	652,711.4	690,132.0

[a]Based on estimates and projections prepared by the staff of the National Energy Board, Ottawa, May, 1970.

[b]Most of these particulates could be removed by precipators.

Table 3.1: PERSONAL INCOME PER CAPITA, PROVINCIAL LEVELS AS PER CENT OF NATIONAL LEVEL

	1927	1947	1953	1958	1968	1973
Canada (current $)	435*	835*	1,317	1,840	2,690	4,254
Provinces (per cent of national level)						
Newfoundland	-	-	51	56	61.5	65
P.E.I.	56	56	49	58	64	69
Nova Scotia	67	80	73	75.5	77	78
New Brunswick	62	72	64	67	70	73
Quebec	85	83	86.5	89	89	90
Ontario	115	115	118	117	117	114
Manitoba	103	103	95	94	97	96
Saskatchewan	101	96	100	98	85	89
Alberta	115	109	106	98	100	102
British Columbia	121	115	120	112	108	108
Yukon & NWT	-	-	103	89	86	86

* Data are for three-year averages centred on the year shown.

Sources: 1927, 1947 from Economic Council of Canada, "Canada's Post-War Economic Performance," in Economic Council, First Annual Review (1964) reprinted in John J. Deutsch, et al., The Canadian Economy: Selected Readings, revised edition, Toronto, 1965, pp. 21-22; all other data from Department of Finance, Annual Review (Ottawa, April, 1975), Reference Table 12, pp. 113-114.

Table 3.2: CANADA: MINERAL PRODUCTION DATA, BY PROVINCE AND REGION 1954, 1969, 1974 (current dollar values)

	Thousands of dollars		
Province or Region	1954	1969	1974
ATLANTIC PROVINCES			
Newfoundland	42,898	239,094	453,509
Prince Edward Island	-	-	-
Nova Scotia	73,905	54,175	81,367
New Brunswick	12,468	98,394	218,733
Total - Atlantic Provinces	129,271	391,663	753,609
QUEBEC	278,818	720,067	1,152,083
ONTARIO	496,748	1,214,457	2,422,312
WESTERN PROVINCES			
Manitoba	35,107	245,596	443,566
Saskatchewan	68,216	347,652	826,382
Alberta	279,043	1,193,280	4,418,058
British Columbia	158,631	422,766	1,186,901
Total - Western Provinces	540,997	2,209,294	6,874,907
TERRITORIES			
Yukon	16,559	37,656	185,194
Northwest Territories	26,414	116,456	228,393
Total - Territories	42,973	154,112	413,587
TOTAL - CANADA	1,488,807	4,689,593	11,616,498
As per cent of total:			
Atlantic Provinces	8.7	8.35	6.5
Quebec	18.7	15.35	9.9
Ontario	33.37	25.9	20.9
Western Provinces	36.33	47.1	59.2
Territories	2.9	3.3	3.56
Total (May add to more than 100% because of rounding)	100.0	100.0	100.06

Source: QUICK CANADIAN FACTS, 30th Edition, 1975, pp. 38-65.

Table 3.3: COMMODITY PRODUCTION BY REGION

(Millions of Short Tons)

(1972/73) 1990

	Pacific (1)	Prairie (2)	Ontario	Quebec	Atlantic (3)	Canada
Coal	(7.8)	(13.2)			(1.6)	(22.6)
	18.4	31.3			3.7	53.4
Iron Ore	(1.6)		(12.3)	(14.8)	(26.4)	(55.1)
	4.4		34.3	41.2	73.3	153.2
Lumber	(15.5)	(1.3)	(1.4)	(3.5)	(0.8)	(22.5)
	16.3	1.4	1.5	3.7	.9	23.7
Paper, Board & Wood Pulp	(8.2)	(2.1)	(7.7)	(12.1)	(4.2)	(34.3)
	12.1	3.1	11.3	17.9	6.1	50.5
Potash		(4.7)				(4.7)
		12.6				12.6
Sulphur	(0.3)	(5.2)	(0.4)	(0.1)	(0.0)	(6.1)
	.6	10.3	0.8	0.2	0.1	12.0
Oil	(3.1)	(91.1)	(.1)		(0.0)	(94.4)
	11.3	61.1			10.8	83.3
Grain	← (33.7) →		← (2.1) →			(35.8)
	← 38.9 →		← 2.4 →			41.4
Steel						(14.8)
						21.1

Notes: (1) B.C. Yukon and Northwest Territories
(2) Alberta, Saskatchewan and Manitoba
(3) New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland

Table 3.4: COMMODITY - VALUE OF PRODUCTION

Millions of $

(1972/73) 1990

	Pacific (1)	Prairie (2)	Ontario	Quebec	Atlantic (3)	Canada
Coal	(85.6)	(66.4)			(19.2)	(171.2)
	202.6	157.3			45.3	405.2
Iron Ore	(13.9)		(145.0)	(128.3)	(325.8)	(613.2)
	38.7		403.4	356.7	906.2	1,705.0
Lumber	(1,116.0)	(92.3)	(116.4)	(246.4)	(60.6)	(1,631.7)
	1,177.8	97.5	122.8	260.1	64.0	1,722.1
Paper, Board & Wood Pulp	(749.6)	(98.9)	(778.1)	(1,099.4)	(401.8)	(3,127.8)
	1,128.7	149.0	1,171.6	1,655.5	605.0	4,709.8
Potash		(151.1)				(151.1)
		406.9				406.9
Sulphur	(4.5)	(65.4)	(6.8)	(1.6)	(0.6)	(78.9)
	8.9	129.6	13.4	3.1	1.3	156.3
Oil/Natural Gas	N/A	N/A	N/A	N/A	N/A	(2,980.0)
Grain	N/A	N/A	N/A	N/A	N/A	N/A
	3,157.9		276.3	3.2	0.5	3,437.9
Steel	N/A	N/A	N/A	N/A	N/A	N/A

Notes: (1) B.C., Yukon and Northwest Territories
(2) Alberta, Saskatchewan and Manitoba
(3) New Brunswick, Nova Scotia, Prince Edward Island

Table 3.5: COMMODITY-RELATED EMPLOYMENT (1972/73) 1990

Thousands

	Pacific (1)	Prairie (2)	Ontario	Quebec	Atlantic (3)	Canada
Coal	(2.2)	(1.8)			(3.7)	(7.7)
	4.0	3.4			6.7	14.0
Iron Ore	(0.3)		(3.5)		(7.4)[4]	(11.2)
	0.6		7.3		15.7	23.6
Lumber	(32.6)	(3.5)	(5.6)	(11.2)	(4.2)	(57.1)
	26.2	2.8	4.5	9.0	3.4	45.9
Paper, Board & Wood Pulp	(16.5)	(2.1)	(21.0)	(29.5)	(9.9)	(79.0)
	18.5	2.3	23.6	33.1	11.1	88.5
Potash		(2.7)				(2.7)
		5.5				5.5
Sulphur		(1.0)				(1.0)
		1.5				1.5
Oil	(0.4)	(3.9)	(0.1)			(4.4)
	N/A	N/A	N/A		N/A	N/A
Grain	N/A	N/A	N/A	N/A	N/A	N/A
Steel	N/A	N/A	N/A	N/A	N/A	N/A

Notes: (1) B.C., Yukon and Northwest Territories
(2) Alberta, Saskatchewan, and Manitoba
(3) New Brunswick, Nova Soctia, Prince Edward Island, Newfoundland
(4) Includes Quebec/Labrador

Table 3.6 MAIN AGGREGATES, 1975-82

(a) Average Annual Change, % (1961 dollars)

	Actual, 1964-72	Projected, 1975-82	
Real Gross National Product	5.0	5.3	
Output per person employed	2.3	2.2	
Corporate profits before taxes	6.8	7.1	(Current $)
Stock of business capital	5.3	6.8	
Business capital per person employed	2.4	3.8	
Residential construction	5.4	3.6	
Plant and equipment outlays	3.7	6.2	
Personal income	10.2	10.2	(Current $)
Personal disposable income	8.9	9.6	(Current $)
Real personal disposable income per capita	3.6	4.0	
Consumer expenditures	4.7	5.4	
Government expenditures on goods and services	5.9	4.8	
Exports of goods and services	9.2	4.9	
Imports of goods and services	8.1	5.0	
Population	1.6	1.4	(Number of perso
Labour Force	3.1	2.7	(Number of perso
Employment	2.8	2.9	(Number of perso
GNE price deflator	4.0	4.6	(Index number)
Consumer expenditure price deflator	3.4	4.1	(Index number)
Consumer price index	3.7	4.6	(Index number)

(b) Annual Averages (1961 dollars)

	Actual, 1965-72	Projected, 1976-82
Current account balance (million $ current)	-388.4	-4,779.1
Current account balance (% GNP)	-0.6	-2.0
Government surplus (+) or deficit (-) (million $ current)	434.3	466.5
Government surplus (+) or deficit (-) (% GNP)	0.6	0.2
Housing starts (000 units)	193.3	253.2
Unemployment rate (% of labour force)	5.0	4.3

Source: Economic Council of Canada, 11th Annual Review

Table 3.7 DEMAND CONFIGURATION, 1975-1982

Average Annual Change, % (1961 dollars)

	Actual, 1964-72	Projected, 1975-82
Real Gross National Product	5.0	5.3
Investment in machinery and equipment	4.8	5.6
Investment in nonresidential construction	2.3	7.0
Residential construction expenditures	5.4	3.6
Consumer expenditures on goods and services	4.7	5.4
Durable goods	5.9	5.7
Nondurable goods	4.5	4.3
Semidurable goods	4.5	4.3
Services	4.5	6.3
Government current expenditures on goods and services	6.6	5.1
Government gross capital formation	3.4	3.8
Exports of goods and services	9.2	4.9
Goods	10.2	4.9
Agricultural products	4.2	3.6
Industrial products	5.7	4.3
Primary	8.5	3.1
Processed	4.2	5.2
Automobiles and other advances manufactured products	17.9	5.7
Services	4.2	4.5
Imports of goods and services	8.1	5.0
Goods	9.1	5.1
Agricultural products	4.4	4.0
Industrial products	6.5	5.2
Automobiles and other advanced manufactured products	11.8	5.2
Services	5.8	4.8

Source: Economic Council of Canada, 11th Annual Review.

Table 3.8 INDUSTRIAL PATTERNS OF GROWTH, 1975-82

Average Annual Percentage Change

	Actual, 1964-72	Projected 1975-82
Total Economy		
Output	5.1	5.1
Employment	2.8	2.9
Output per man-hour	3.2	3.0
Capital stock	5.3	6.8
Manufacturing		
Output	4.9	5.4
Employment	1.3	1.4
Output per man-hour	3.9	4.4
Capital stock	5.3	6.7
Construction		
Output	3.8	5.4
Employment	1.4	2.5
Output per man-hour	3.3	3.5
Capital stock	3.1	5.5
Utilities		
Output	8.4	6.4
Employment	3.2	-0.1
Output per man-hour	6.1	9.4
Capital stock	6.8	8.4
Transportation, storage, communications		
Output	6.2	5.3
Employment	2.4	0.4
Output per man-hour	4.7	5.7
Capital stock	3.5	6.0
Finance		
Output	5.6	5.4
Employment	4.9	5.2
Output per man-hour	0.9	-0.1
Capital stock	8.5	8.0
Trade		
Output	4.9	5.0
Employment	2.9	2.9
Output per man-hour	3.1	3.0
Capital stock	3.6	2.7

Table 3.8 (Continued)

	Actual, 1964-72	Projected, 1975-82
Services		
Output	6.0	4.9
Employment	5.7	5.0
Output per man-hour	1.3	0.7
Capital stock	8.6	7.3
Agriculture		
Output	1.6	4.1
Employment	-2.8	-2.4
Output per man-hour	5.1	6.5
Capital stock	1.9	4.3
Forestry		
Output	1.0	5.2
Employment	-1.4	1.2
Output per man-hour	-2.7	5.3
Capital stock	4.3	5.5
Fishing		
Output	-0.3	1.2
Employment	-2.5	0.2
Output per man-hour	3.1	2.2
Capital stock	4.5	4.2
Mining, oil, and gas		
Output	5.8	4.7
Employment	3.3	-1.2
Output per man-hour	2.4	6.5
Capital stock	8.7	8.8
Public Administration		
Output	3.3	4.0
Employment	4.6	4.2
Output per man-hour	-0.5	0.8

Source: Economic Council of Canada, 11th Annual Review

Table 4.1: INDEX OF WORLD FOOD SECURITY

Year	Reserve Stocks of Grain	Grain equivalent of idle American Cropland	Total Reserves	Reserves as Share of Annual Grain Consumption	Reserves as days of Consumption
1961	154	68	222	26	94
1962	131	81	212	24	88
1963	125	70	195	21	77
1964	128	70	198	21	77
1965	113	71	184	19	69
1966	99	79	178	18	66
1967	100	51	151	15	55
1968	116	61	177	17	62
1969	136	73	209	19	69
1970	146	71	217	19	69
1971	120	41	161	14	51
1972	131	78	209	18	66
1973	103	20	123	10	37
1974 (proj.)	89	0	89	7	27

Source: Brown, Lester B., World Population & Food Supplies: Looking Ahead
Overseas Development Council, 1974.

Table 4.2: THE CHANGING PATTERN OF WORLD GRAIN TRADE

Region	1934-38	1948-52	1960	1966	1973 (prel.) (fiscal year)
	- million metric tons -				
	(plus = net exports; minus = net imports)				
North America	+5	+23	+39	+59	+88
Latin America	+9	+1	0	+5	-4
Western Europe	-24	-22	-25	-27	-21
Eastern Europe & USSR	+5	--	0	-4	-27
Africa	+1	0	-2	-7	-4
Asia	+2	-6	-17	-34	-39
Australia & New Zealand	+3	+3	+6	+8	+7

Source: Brown, Lester B., World Population & Food Supplies: Looking Ahead
Overseas Development Council 1974

Table 4.3: WATER USE IN CANADA-1972

(Millions of Imperial Gallons per day-Mgd)

In 1972, an estimated 31,087 million gallons per day (mgd) of fresh water, equivalent to some 1,400 gallons per day per person were used for (1) Public Supply - municipal and rural; (2) Industrial Use - manufacturing and the mineral industries; (3) Agricultural Use, and (4) Thermoelectric Generation. The water withdrawals required to cover these uses are shown below by region and principal use:

	Municipal	Manufacturing	Mineral Industry	Agriculture	Thermo-electric	Total
Atlantic	159	598	100	12	165	1,034
Quebec	696	1,823	52	61	276	2,908
Ontario	735	2,882	94	117	7,730	11,558
Prairies	259	613	252	1,054	2,103	4,281
British Columbia	230	1,028	64	284	119	1,725
Yukon & NWT	6	-	13	-	-	19
	2,085	6,944	575	1,528	10,393	21,525

The quantities in the table are estimates of the water withdrawn from its natural source, most of which was eventually returned to the environment, sometimes in the same state as it was withdrawn, but at other times, considerably different. The quantity of water consumed, that is, the amount no longer available for further possible withdrawal because of evaporation, incorporation in manufacturers' products, and other causes, is estimated to total about 10% of the water withdrawn.

Recirculation allows some of the water which is withdrawn to be used and reused. Recirculation in manufacturing alone has made it possible to extend the 6.944 mgd to meet a gross demand of 16,506 mgd and, in terms of all water uses in Canada, the 21,525 mgd has been stretched to meet a gross demand of 31,087 mgd.

Uses of water not covered in the table include hydroelectric generation, fish, wildlife, navigation and recreation, all of which are normally non-withdrawal uses.

Source: Environment Canada, Inland Waters Directorate: National Water Need Study, April 1973, unpublished.

Table 4.4: CURRENT AGRICULTURAL WATER WITHDRAWALS, BY REGION

In millions of gallons per day-mgd

Region	Irrigation	Stockwatering	Total
Atlantic	.7	11.7	12.4
Quebec	.8	59.9	60.7
Ontario	32.4	84.1	116.5
Prairies	930.1	124.4	1,054.5
British Columbia	267.7	16.1	283.8
Yukon and Northwest Territories	-	-	-
Canada Total	1,231.7	296.2	1,527.9

Source: Environment Canada, Inland Waters Directorate: National Water Need Study, April 1973, unpublished.

Table 4.5: IRRIGATION BY REGION

Region	Land under Irrigation		Water used for Irrigation	
	Acres	Number of Farms	Withdrawn	Consumed
			(acre-feet per year)	
Atlantic	5,659	323	916	652
Quebec	92,895	2,418	1,105	885
Ontario	99,472	3,880	43,499	34,500
Prairies	622,140	4,747	1,251,019	537,503
British Columbia	220,987	5,794	360,072	158,768
Yukon & Northwest Territories	7	2	-	-
Canada Total	1,041,160	17,164	1,656,611	732,308

Source: Environment Canada, National Water Need Study, April 1973, unpublished.

Statistics Canada: 1971 Census of Canada, Agriculture, Advance Bulletin, August, 1972.

Table 4.6: AVERAGE ANNUAL WATER DEFICIENCIES FOR 19 CMA's IN CANADA, 1966
(BASED ON PRECIPITATION AND EVAPO-TRANSPIRATION)

In Inches

Halifax - 0"
Saint John, N.B. - 0"
St. John's, Nfld. - 0"
Quebec - 0"
London - 1"
Kitchener - 1"
Sudbury - 1"
Montreal - 1"
Ottawa - 2-3"
Calgary - 2-4"
Toronto - 3-4"
Hamilton - 4"
Edmonton - 4-5"
Windsor - 4-5"
Winnipeg - 4-5"
Vancouver - 4-8"
Regina - 6-8"
Saskatoon - 6-8"
Victoria - 8-9"

Source: Williams, G.P.V., Plant Research Institute, Ottawa, from Chapman & Brown, 1966, The Climates of Canada for Agriculture (CLI, ARDA, Report No. 3).

Table 4.7 ESTIMATED DAILY MUNICIPAL WASTE LOADINGS BY REGION, 1972

Region	Waste Loading before Treatment[1] In thousands of lbs./day day BOD	Suspended Solids	Phosphates	Net Waste Loading after Treatment[2] In thousands of lbs./day day BOD	Suspended Solids	Phosphates	Removal[3] Efficiency (%)
Pacific	281	331	14.3	186	215	13.8	34
Prairie	403	475	18.7	93	106	16.6	77
Ontario	1,078	1,359	52.9	327	374	46.8	68
Quebec	826	972	38.8	722	848	34.4	13
Atlantic	196	230	9.7	132	137	9.4	33
	2,784	3,367	134.4	1,460	1,680	121.0	Avg. 45

1 In calculating municipal waste loadings, standard daily per capita co-efficients were used. These were: 0.17 lb of BOD; 0.2 lb of suspended solids; and 8 ppm of phosphate (100 gallons of wastewater per capita assumed)

2 In calculating net waste loadings after treatment, standard waste removal efficiences were used. These were: for primary treatment, 25% BOD removal, 30% suspended solids removal, and no phosphate removal; for secondary treatment, 85% BOD removal, 85% suspended solids removal, and 27.5% phosphate removal. For locations with tertiary treatment, BOD and suspended solid removal efficiency rates are assumed to be the same as for secondary treatment, while the phosphate removal efficiency is assumed to be 90%, in calculating these data, the proportion of the urban population with untreated wastes has been considered.

3 Average of BOD and suspended solids removal efficiencies only.

Table 4.8 ESTIMATED WATER WITHDRAWALS ASSOCIATED WITH THERMAL GENERATION - 1972

(In millions of gallons per day)

	Fresh Water Conventional Thermal Plants	Nuclear Thermal Plants	Saline Water Conventional Thermal Plants
Atlantic	60	105*	898
Quebec	36	240	-
Ontario	5,950	1,780*	-
Prairies Provinces	2,103	-	-
British Columbia	119	-	200
	8,268	2,125	1,098

* includes water used to produce heavy water

Table 4.9: ENERGY IN CROP PRODUCTION - CANADA 1971

	Canada	Saskatchewan	Ontario
Direct Energy Use			
Fuel - Tractors, Combines BTU x 10^{12}	45.4	15.5	10.6
Fuel - Cars, Trucks BTU x 10^{12}	47.0	12.7	10.0
Electricity BTU x 10^{12}	0.8	0.1	0.3
TOTAL DIRECT - BTU	104.2 x 10^{12}	28.3 x 10^{12}	20.9 x 10^{12}
Indirect Energy Use			
Machinery Production - BTU x 10^{12}	5.3	1.1	1.4
Car & Truck Production- BTU x 10^{12}	8.0	2.0	1.9
Fertilizer Production - BTU x 10^{12}	166.0	8.0	72.0
Miscellaneous - BTU x 10^{12}	56.0	8.0	19.0
TOTAL INDIRECT - BTU	235.3 x 10^{12}	19.1 x 10^{12}	94.3 x 10^{12}
TOTAL D & ID INPUT - BTU	339.5 x 10^{12}	47.4 x 10^{12}	115.2 x 10^{12}
TOTAL INPUT/ACRE - BTU	3.55 x 10^{6}	1.05 x 10^{6}	14.2 x 10^{6}
ENERGY OUTPUT (TABLE 1)/ ENERGY INPUT RATIO:	3.20	7.6	2.05
FUEL - GALS./ACRE	7.6	4.6	18.0
TOTAL ENERGY INPUT - EQ. GALS/ACRE	23.0	6.6	92.0

Source: Downing (13)

Table 4.10: TOTAL NOMINAL FISH CATCH 1967-73 (METRIC TONS)

YEAR	(a) WORLD (in 000's)	CANADA				
		(a) CANADA (in 000's)	% of World Total	(b) Atlantic Nominal Catch (in 000's)	Atlantic, as % of Canadian Total	Landed Value of Canadian Catch (in 000's)
1967	60,400	1,296	2.14	1,041	80.3	165
1968	63,900	1,499	2.34	1,268	84.5	186.1
1969	62,700	1,405	2.23	1,208	85.9	183.8
1970	70,000	1,389	1.98	1,174	84.5	204.9
1971	70,200	1,290	1.83	1,095	84.8	205.0
1972	65,500	1,169	1.78	931	79.6	236.0
1973	65,700	1,151	1.75	891	77.4	320.2 (e)

a) Yearbook of Fisheries Statistics, FAO, 1973
b) Annual Statistical Review of Canadian Fisheries, Environment Canada, Vol. 6, 1973
e) estimated

Table 4.11

LANDINGS AND VALUES

SUMMARY OF LANDINGS AND VALUES, BY REGION, 1955 - 73
SOMMAIRE DES DÉBARQUEMENTS ET VALEURS, PAR RÉGION, 1955 - 73

Quantities in million pounds and in thousand metric tons. Values in million dollars.
Quantités en millions de livres et en milliers de tonnes métriques. Valeurs en millions de dollars.

Year / Année	ATLANTIC / ATLANTIQUE (a) Landings / Quantités débarquées	(b) Nominal catches / Captures nominales	(c) Landed value / Valeur au débarquement	(d) Marketed value / Valeur marchande	PACIFIC / PACIFIQUE (a) Landings / Quantités débarquées	(b) Nominal catches / Captures nominales	(c) Landed value / Valeur au débarquement	Marketed value / Valeur marchande
1955	1,293.0	664.1	50.6	104.7	497.2	231.4	28.3	61.5
1960	1,337.7	704.0	59.8	124.8	340.5	162.4	29.0	55.2
1965	1,667.2	888.6	97.6	201.6	626.1	294.1	47.5	89.9
1966	1,913.6	995.3	100.5	212.2	574.7	271.5	60.7	123.7
1967	2,057.0	1,040.7	103.6	209.2	332.6	159.8	49.6	104.5
1968	2,530.0	1,267.5	115.7	240.4	267.2	131.1	57.4	123.9
1969	2,425.4	1,207.5	120.7	271.0	174.0	88.4	47.4	87.9
1970	2,374.7	1,174.0	131.4	277.8	238.5	117.0	60.3	123.3
1971	2,217.2	1,094.7	133.3	316.4	228.7	113.4	58.6	120.2
1972	1,862.5	931.2	145.1	354.7	337.5	162.3	75.1	159.1
1973(e)	1,790.3	891.0	171.3	448.3	388.8	183.8	130.4	285.0

Year / Année	FRESHWATER FISHERIES / PÊCHES D'EAU DOUCE (a) Landings / Quantités débarquées	(b) Nominal catches / Captures nominales	(c) Landed value / Valeur au débarquement	Marketed value / Valeur marchande	CANADA - TOTAL / CANADA - TOTAL (a) Landings / Quantités débarquées	(b) Nominal catches / Captures nominales	(c) Landed value / Valeur au débarquement	(d) Marketed value / Valeur marchande
1955	119.0	54.0	13.1	18.6	1,909.2	949.5	92.0	184.8
1960	123.1	55.8	12.8	19.3	1,801.3	922.2	101.6	199.3
1965	120.1	54.5	15.0	21.2	2,413.4	1,237.2	160.1	312.7
1966	121.4	55.1	14.9	20.6	2,609.7	1,321.9	176.1	356.5
1967	106.8	48.4	11.8	16.3	2,496.4	1,248.9	165.0	330.0
1968	115.1	52.2	13.0	19.8	2,912.3	1,450.8	186.1	384.1
1969	120.3	54.5	15.7	23.0	2,719.7	1,350.4	183.8	381.9
1970	94.6	42.9	13.2	19.2	2,707.8	1,333.9	204.9	420.3
1971	91.5	41.5	13.1	19.1	2,537.4	1,249.6	205.0	455.7
1972	93.6	42.5	15.8	24.5	2,293.6	1,136.0	236.0	538.3
1973(e)	100.4	45.5	18.5	29.4	2,279.5	1,120.3	320.2	762.7

a) - Fish and shellfish only. Landings in million pounds, common landed form (i.e. weight of catch as landed).
- Ne comprend que les poissons, mollusques et crustacés. Quantités débarquées en millions de livres, forme commune des débarquements (i.e. poids du poisson tel que débarqué).

b) - Fish and shellfish only. Nominal catches in thousand metric tons (i.e. the live weight equivalent of the landings).
- Ne comprend que les poissons, mollusques et crustacés. Captures nominales en milliers de tonnes métriques (i.e. équivalent en poids vif des quantités débarquées).

c) - Includes marine plants, aquatic mammals, livers, etc.
- Y compris également les plantes marines, mammifères marins, foies, etc.

d) - Excludes duplication.
- A l'exclusion de toute duplication.

e) - Preliminary.
- Chiffres préliminaires.

Source: Annual Statistical Review of Canadian Fisheries, p. 31.

Table 4.12: TRENDS IN KEY FOREST PRODUCTS

(Canada)

	Lumber		Wood Pulp		Newsprint	
	Production	Exports	Production	Exports	Production	Exports
	Million board feet		- '000 tons -		- '000 tons -	
1950	6,948 (1951)	-	8,473	1,846	5,279	4,956
1960	8,013	4,574	11,461	2,602	6,739	6,265
1967	10,330	6,487	15,857	4,269	8,052	7,330
1968	11,351	7,182	16,762	4,971	8,031	7,422
1969	11,538	6,876	18,590	5,795	8,818	8,089
1970	11,270	7,466	18,308	5,581	8,719	7,988
1971	12,735	8,526	18,234	5,676	8,455	7,641
1972	13,985	9,792	19,239	6,102	8,820	8,120
1973	15,970 (est.)	9,969	20,506 (est.)	6,517	9,140	8,340

Sources: Statistics Canada, Canadian Forestry Statistics, Catalogue 25-202

Canadian Pulp & Paper Association, Reference Tables, 1974.

Table 4.13: PROJECTED U.S. DEMAND AND IMPORTS FOR KEY FOREST PRODUCTS

(medium projections at 1970 relative prices)

	Lumber (Billion board feet)		Wood Pulp (million tons)		Paper and Board (million tons)	
	Consumption	Imports	Consumption	Imports	Consumption	Imports
1970	39.2	6.1	44.1	3.5	57.9	7.2
1980	44.5	9.0	64.9	5.1	83.1	8.7
1990	46.6	12.0	84.1	7.0	116.1	10.0
2000	45.7	13.9	106.6	8.6	156.6	11.3

Source: U.S. Department of Agriculture, Forest Service, The Outlook for Timber in the United States, 1973.

Table 4.14 DOMESTIC DEMAND FOR KEY FOREST PRODUCTS

	Actual	Forecasted		Annual Growth Rates	
	1970*	1981		1960-70	1970-81
Softwood Lumber (million board feet)	4,068	5,000		2.2%	1.9%
Wood-based Panels (million square feet)	3,365	5,000		5.8%	3.9%
(Particleboard)	(231)	(700)		(**)	(10.6%)
		1980	1985	1970-80	1970-85
Paper and Board*** (thousand metric tons)	3,173	5,504	6,826	4.9%	7.3% 11.5%

---

* Except for Paper and Board, a 1969-71 average.

** Not applicable due to negligible use in 1960.

*** Using adjusted potential (middle) projections.

Sources: F.L.C. Reed and Associates, The Canadian Panel Board Market, Vancouver, 1972.
Interdepartmental Committee for Review of the Canadian Pulp and Paper Industry, Consumption Projections for Paper 1970-85, Ottawa, 1972.

Table 4.15: CANADA'S RESERVE TIMBER SUPPLY*

	Softwoods	Hardwoods	Total	Potential Increase in Supply (Est.)
	- million cubic feet -			
Allowable cut	6,916	1,152	8,068	X
Actual Cut (1970-71)	3,838	306	4,144	X
Surplus	3,078	846	3,924	95%
Distribution:				
B.C.	1,292	----	1,262	57%
West-Central	431	415	846	79%
Ontario	369	220	589	13%
Quebec	739	76	815	10%
Atlantic	246	135	381	10%
Territories	62	----	62	3900%
Product suitability:				
Lumber	1,614	353	1,967	215%**
Veneer	372	98	470	
Pulp	1,092	395	1,487	104%
Chips (by-product from lumber and veneer)	588	138	726	

*Derived from adjusted provincial allowable cut formulae, and a concept of "economic" surplus based on extraction costs under present technology, management and utilization practices.

**Estimated increases, excluding wood used for "other primary products" such as fuelwood, poles, etc. Total percentage increase is higher than surplus due to "recycling" effect of chips for pulp production.

SOURCE:
(Except last column); F.L.C. Reed & Associates Ltd., Forest Sector Development in Canada: Problems and Opportunities, 1974.

Table 4.16: SOME CURRENT AND POTENTIAL SUBSTANTITUTES USING FOREST PRODUCTS

	PAPER	METAL	PLASTIC	GLASS	CONCRETE
WOOD	Wallboards Boxes	Construction - large beams, house framing, sidings, window & door frames, bridges, fencing, panels.	Construction - sidings, panels, mouldings, shelving, flooring "lumber"	Doors and Walls	Construction - house foundations, stairs, walkways, fences, flooring.
		Manufacture - furniture, toys, boats, ladders, stationery items, etc.	Manufacture - furniture, toys, boats, clothes pegs, tooth picks, pallets, containers, stationery items, kitchenware.		Manufacture - boats, poles, railway ties, outdoor furniture.
PAPER	X	Packaging - wrappings, liquid containers, trays, boxes.	Packaging - wrappings, bags, beverage containers, trays, boxes, cartons. Manufacture - cups, plates, stationery items, other disposable items. Overlays on other materials - wallpaper, wire coatings, etc. Possibility of plastic "paper"	Beverage and other - liquid containers, cups, dishes, medical equipment (disposable).	- - - - -

Table 4.17: SOLID MATERIAL INPUTS REQUIRED TO PRODUCE CONSTRUCTION MATERIALS

	Aluminum	Steel	Concrete		Lumber
			Block	Ready-mix 6" thick	
Direct raw materials (tons per ton output)	6.0	2.7	----1.0----		2.6
Raw Materials including those of Major inputs (tons per ton output)	15.2	10.0	----1.0----		3.4
Solid materials "processed" per lineal foot of exterior wall (pounds)	44.6	84.6	302.0	563.2	45.6
Relative Social Cost of Environmental Impact (1970)* per lineal foot of exterior wall ($)	0.23	0.11	1.33	0.59	0.02
(% of 1970 price)	28%	9%	48%	24%	2%

*Based on the costs of avoiding environmental impacts from production processes as opposed to estimating "damage functions" which are likely to be greater and to change relative positions.

Source: Dane, C.W., "The Hidden Environmental Costs of Alternative Materials Available for Construction", Journal of Forestry, December, 1972.

Table 4.18 APPROXIMATE RELATIONSHIPS BETWEEN THE MINERAL INDUSTRY AND THE CANADIAN ECONOMY

MINERAL ACTIVITY	DIRECT EFFECTS			INDIRECT EFFECTS
	MINING %	PROCESSING %	TOTAL %	%
GNP	2.7	2.9	5.6	8.4
Labor Force	1.0	2.0	3.1	4.9
Wages and Salaries	1.6	2.8	4.4	7.6
Capital Expenditures	4.6	4.2	8.8	N.A.
Merchandise exports	11.6	13.5	25.1	N.A.
Merchandise imports	2.2	8.3	10.5	N.A.

Source - Toward a Mineral Policy for Canada, EMR 1974.

Table 4.19 CANADIAN MINERAL PRODUCTION BY PROVINCE (1973)

Province	% of Total
ONTARIO	35.5%
QUEBEC	18.1%
BRITISH COLUMBIA	15.3%
MANITOBA	7.8%
NEWFOUNDLAND	7.6%
NORTHERN TERRITORIES	6.2%
SASKATCHEWAN	4.0%
NEW BRUNSWICK	3.0%
ALBERTA	1.6%
NOVA SCOTIA	0.9%

Source - Toward a Mineral Policy for Canada, EMR 1974.

Table 4.20 CURRENT MINERAL RESERVES IN CANADA

Commodity	Years of assured reserve at growth rates of: 2.5%	3.5%	4.5%	Expectations of extension at present prices
Aluminum	-	-	-	poor[1]
Asbestos	119	95	80	average
Copper	32	28	26	excellent
Iron	58	50	44	excellent
Lead	27	25	23	excellent
Molybdenum	26	24	22	excellent
Nickel	30	27	25	excellent
Potash	239	181	147	excellent
Sulphur	27	25	23	excellent
Tin Zinc	-	-	-	poor
	23	21	19	excellent

1. Even though aluminum ore is presently imported there are aluminum bearing materials existing in Canada that new technology could make available.

Source: Toward a Mineral Policy for Canada, (1974), EMR

Table 4.21 FORECAST PRODUCTION FOR MAJOR METALS 1970-2000

	PRODUCTION*			AVERAGE ANNUAL GROWTH
	1970	1980	2000	1980-2000
	(thousands of tons)			(%)
Nickel	308(95)	400(95)	600(93)	2.0
Copper	674(67)	1,200(71)	2,300(65)	3.3
Lead	383(85)	470(83)	700(86)	2.0
Zinc	1,211(92)	1,880(88)	3,000(85)	2.5
Iron	53,900(81)	80,000(81)	150,000(75)	2.7
Molybdenum	16(93)	21(95)	46(94)	7.2
Uranium	4(0)	13(91)	64(88)	10.14
Asbestos	1,654(96)	2,200(96)	3,980(90)	3.0
Potash	3,424(95)	7,300(95)	23,430(95)	6.0

*Note: % of total exported in brackets

Source: Mineral Area Planning Study, 1975, EMR, and Toward a Mineral Policy for Canada, 1974, EMR p 27, Table 8.

Table 4.22 PRODUCTION OF MAJOR METAL REQUIREMENTS FROM NEW SOURCES: 1976-2000

	1976-1980 new	1981-1985 new	1986-1990 new	1991-1995 new	1996-2000 new
Copper	2%	7%	16%	37%	52%
Zinc	-	-	13%	37%	56%
Lead	-	-	-	22%	47%
Molybdenum	-	4%	12%	32%	42%
Uranium	5%	29%	58%	75%	80%
Nickel	known	sources	sufficient		
Iron	known	sources	sufficient		

Source: MAPS, 1975

Table 4.23 FORECASTS OF MINE STARTS AND CLOSURES IN CANADA FOR 5-YEAR PERIODS: 1974-1994,

PROVINCE	1974-79			1980-84			1985-89			1990-94		
	S	C	S/C	S	C	S/C	S	C	S/C	S	C	S/C
NFLD	2	1		1	2			1		1		
NS	1				2			1			1	
NB	1	2	1	3			1	1			1	
QUE	5	16	1		3		3	8		1	1	
ONT	7	14	1	1	5		1	4			5	
MAN		2		1				2		1	2	
SASK	2			2				1			3	
ALTA		5						1				
BC	7	6	3	6	9		5	3			1	
YUKON	1	2		3	1	1		1				
NWT	2	3					1				2	
TOTAL	28	51	6	17	22	1	11	23		3	16	

*Note: S-mine starts; C-mine closures; S/C mine start and closure
Source: MAPS, 1975

Table 5.1: STANDARD FORECAST OF CANADA'S PRIMARY ENERGY CONSUMPTION (10^{15}Btu)

	1970	1980	1990	2000
Petroleum products	2.9(58)*	4.6-5.1	6.0-9.4	8.2-13.5
Natural gas	1.1(22)	2.0-2.5	2.0-5.4	2.4-7.7
Coal, coke	0.3(6)	0.3	0.3	0.4
Electricity	0.7(14)	1.4	2.4	3.9
	5.0(100)	8.8-93	14.2-18.5	20.2-25.5

*Note: % of total in brackets

Source: An Energy Policy for Canada, 1973, EMR, Vol. 1, Table 5.

Table 5.2: FORECAST OF ENERGY USAGE FOR CANADA: FOR THE YEAR 2000

	1971	2000
Residential	25%	
(gas-oil-80%)*		28%
(electricity-20%)*		
Commercial	15%	
(gas-oil-75%)		
(electricity-25%)		
Transportation	25%	28%
(oil-99%)		
(other-1%)		
Industrial	35%	44%
(gas-oil-63%)		
(coal-13%)		
(electricity-24%)		

*Note: 1971 proportions

Source: Canada's Energy Opportunities, Max 1975, Science Council of Canada Report, No. 23, Table 1.

Table 5.3: EXPECTED POWER DEVELOPMENTS BY PROVINCE; 1975-2005: NUMBER AND AVERAGE SIZE IN MEGAWATTS

1. Hydro

	1975-9	1980-4	1985-9	1990-2005	Total
British Columbia	7(545)	6(660)	7(425)	3(1300)	23(2930)
Alberta	-	-	1(1500)	-	1(1500)
Saskatchewan	1(300)	-	1(300)	-	2(600)
Manitoba	1(170)	2(990)	1(1000)	1(1000)	5(3160)
Ontario	1(75)	-	-	-	1(75)
Quebec	2(45)	-	1(10775)	1(6000)	4(16820)
Maritimes	2(110)	-	-	-	2(110)
Newfoundland	5(415)	-	-	2(255)	7(670)
	19(1660)	8(1650)	11(14000)	7(8555)	45(25865)

2. Fossil Fuel

British Columbia	-	-	1(4000)	3(2100)	4(6100)
Alberta	4(310)	4(470)	1(750)	4(700)	13(2230)
Saskatchewan	1(100)	1(1200)	2(450)	5(800)	9(2550)
Manitoba	-	-	-	2(2200)	2(2200)
Ontario	1(2150)	1(2000)	2(3000)	7(3000)	11(10150)
Quebec	-	-	-	4(3000)	4(3000)
Maritimes	2(550)	1(300)	2(525)	1(3000)	6(4375)
Newfoundland	-	-	-	2(300)	2(300)
	8(3110)	7(3970)	8(8725)	28(15100)	51(30905)

3. Nuclear

British Columbia	-	-	-	6(2800)	6(2800)
Alberta	-	-	-	1(3000)	1(3000)
Saskatchewan	-	-	-	-	-
Manitoba	-	-	-	2(1800)	2(1800)
Ontario	1(2980)	3(2700)	3(3000)	7(5750)	14(14430)
Quebec	1(635)	-	1(3000)	8(2700)	10(6335)
Maritimes	-	1(600)	-	2(1350)	3(1950)
Newfoundland	-	-	-	2(900)	2(900)
Total	2(3615)	4(3300)	4(6000)	28(18300)	38(31215)
Total	29(8385)	19(8920)	23(28725)	63(41935)	134(87985)
Percentages	22%(9.6%)	14%(10.1%)	17%(32.7%)	47%(47.6%)	100%(100%)

TABLE 5.4

FORECAST OF
CANADIAN REQUIREMENT FOR PETROLEUM PRODUCTS

Thousands of barrels per day

CANADA	NEB Estimate *	Range of Industry Estimates
1975	1800	1742 - 1956
1980	2295	2134 - 2477
1985	2790	2532 - 3038
1990	3360	3003 - 3778
1995	4020	3430 - 4435
West of Ottawa Valley		
1975	915	921 - 1055
1980	1185	1140 - 1367
1985	1425	1359 - 1638
1990	1700	1600 - 2019
1995	2020	1830 - 2415
East of Ottawa Valley		
1975	885	797 - 901
1980	1110	926 - 1126
1985	1365	1148 - 1425
1990	1660	1384 - 1729
1995	2000	1600 - 2020

* Does not include the effect of conservation on Canadian consumption.

Table 5.5: COMPARISON OF THRESHOLD VALUES AND LEAD TIMES FOR FRONTIER OIL SUPPLY

	Mackenzie Delta Beaufort Sea			Scotian Shelf			Arctic Islands			Grand Banks			Labrador Coast		
	Reserves	Rate	Lead Time	Reserves	Rate	Lead Time	Reserves	Rate	Lead Time	Reserves	Rate	Lead Time	Reserves	Rate	Lead Time
BP Canada														300 to 500	8 to 10
Canadian Petroleum Association	2.5	300	5												
Gulf Oil Canada Ltd.	2.5	500		0.5											
Imperial Oil Limited	0.5 to 1.0	100 to 200	7 to 11	0.2			East 0.5 to 1.0 West 7			0.2			0.75		
Independent Petroleum Association of Canada		300 to 500													
Amoco Canada Petroleum Company Ltd.	2.2 to 2.5			0.2 or More		5									
Canada-Cities Service Ltd.	2.2			0.2 or More		3 to 4			East 6-10 West 10-15			5			
Nobil Oil Canada Ltd.	2.0 to 2.5			Less Than Mackenzie Delta											
Shell Canada Limited	2.0		7	0.2 to 0.3			East 0.5 West 7						1.0 to 2.0		

Reserves: Billions of Barrels
Rate: Thousands of Barrels per day
Lead Time: Years from Discovery to Production

Source: NEB report "In the Matter of the Exportation of Oil", 1974

Table 5. 9. RELATIVE ENERGY CONSUMPTION OF VARIOUS MODES OF TRANSPORTATION

A. PASSENGER TRANSPORT

MODE	ENERGY BTU/passenger-mile	RELATIVE CONSUMPTION
(a) INTERCITY *		
Bus	1600	0.47
Railroad	2900	0.85
Automobile	3400	1.00 (base)
Airplane	8400	2.47
(b) URBAN **		
Automobile	8100	1.00 (base)
Mass Transit	3800	0.47

* Load factors (percentage of transport capacity utilized) for intercity travel are about: bus, 45%; railroad, 35%; automobile, 48%; and airplane, 50%

** Load Factors for urban travel are about: automobile, 28%; and mass transit, 20%

B.

MODE	ENERGY BTU/ton-mile	RELATIVE CONSUMPTION
Pipeline	450	0.67
Railroad	670	1.00 (base)
Waterway	680	1.01
Truck	2,800	4.18
Airplane	42,000	62.69

Source: "Efficiency of Energy Use in the United States," Eric Hirst, Science , Vol. 179, p. 1300.

Table 5.10: SELECTED ESTIMATED COST OF ENVIRONMENTAL PROTECTION AND USE FOR THE 1974-1983 DECADE.

1. Transportation: Automobiles:

Yearly cost per vehicle	$200-$300
Cost per mile	7%
Yearly cost for total Canadian vehicle production (estimated at about 900,000 vehicles per year)	$180-$270 million

2. Power: Electricity Generation Facilities

Using normal fuel oil	1 mill/kWh
Using desulphurized heavy fuel oil	1.7 mill/kWh

3. Industry:

Iron and steel*	2-3% of selling price
Aluminum, lead, zinc smelting and refining*	7-10% of selling price
Pulp and paper	1-2% of selling price

Source: An Energy Policy for Canada, Vol II, Chap 6-8; Mines and Resources; Information Canada Cat. No. M27-373

* Note: Additional source - The Economic Impact of Pollution Control, CEQ, March 1972

APPENDIX C - FIGURES

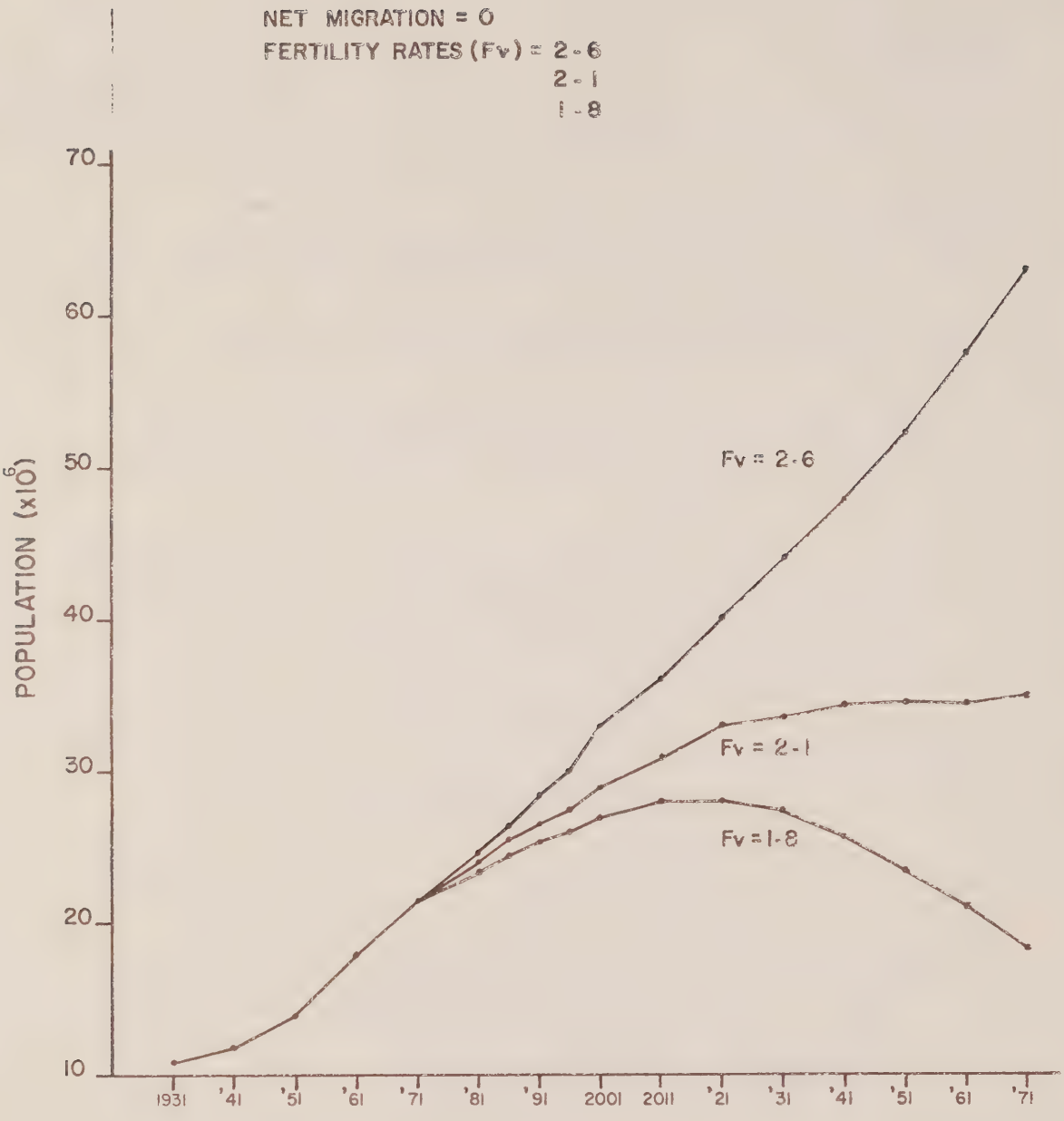


Figure 1.1: POPULATION PROJECTIONS FOR CANADA ASSUMING NET MIGRATION OF 0 AND FERTILITY RATES OF 1.8, 2.1 AND 2.6

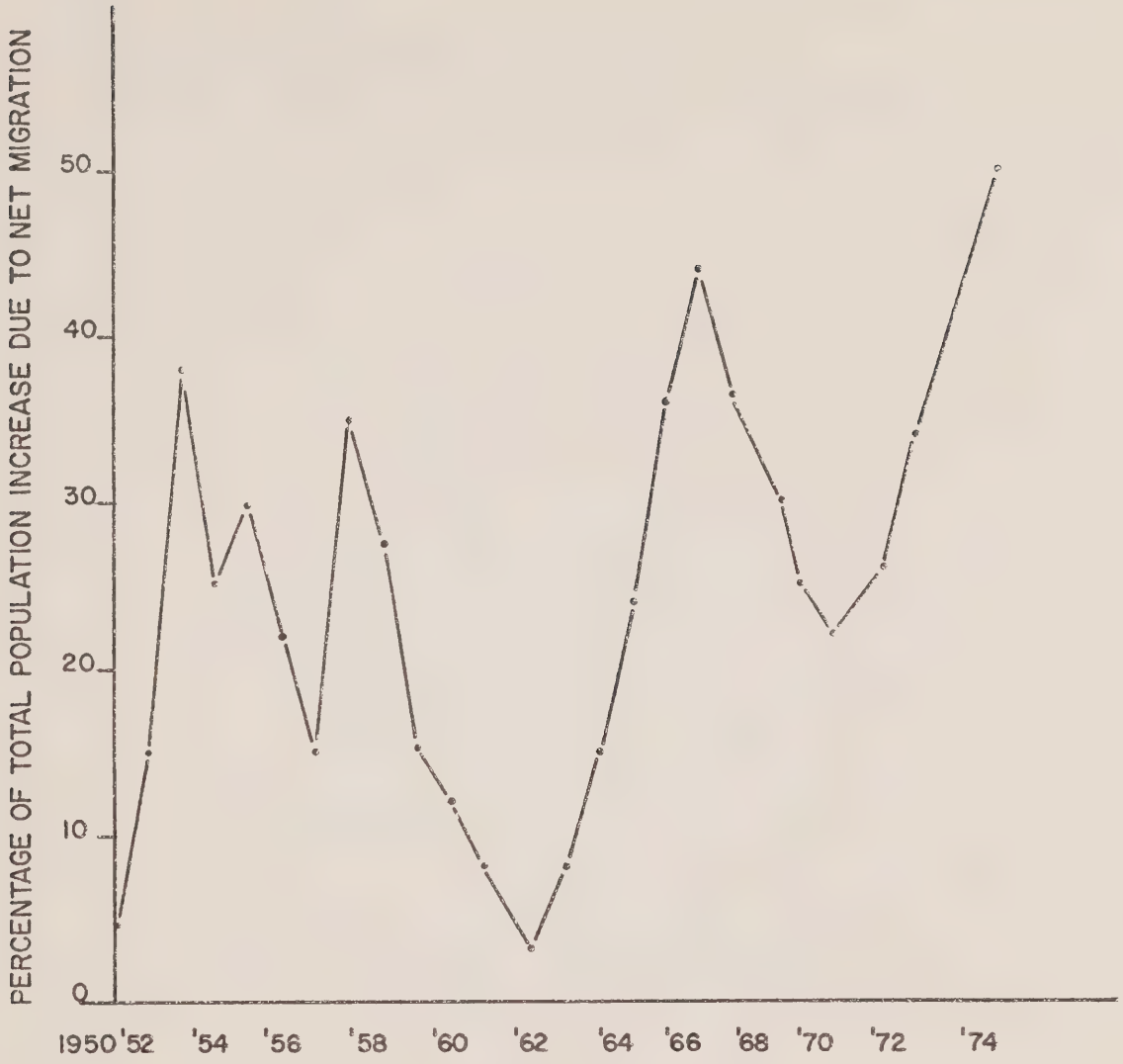


Figure 1.2: PERCENTAGE CONTRIBUTION OF NET MIGRATION TO THE ANNUAL INCREASE IN CANADA'S POPULATION; 1950 TO 1973

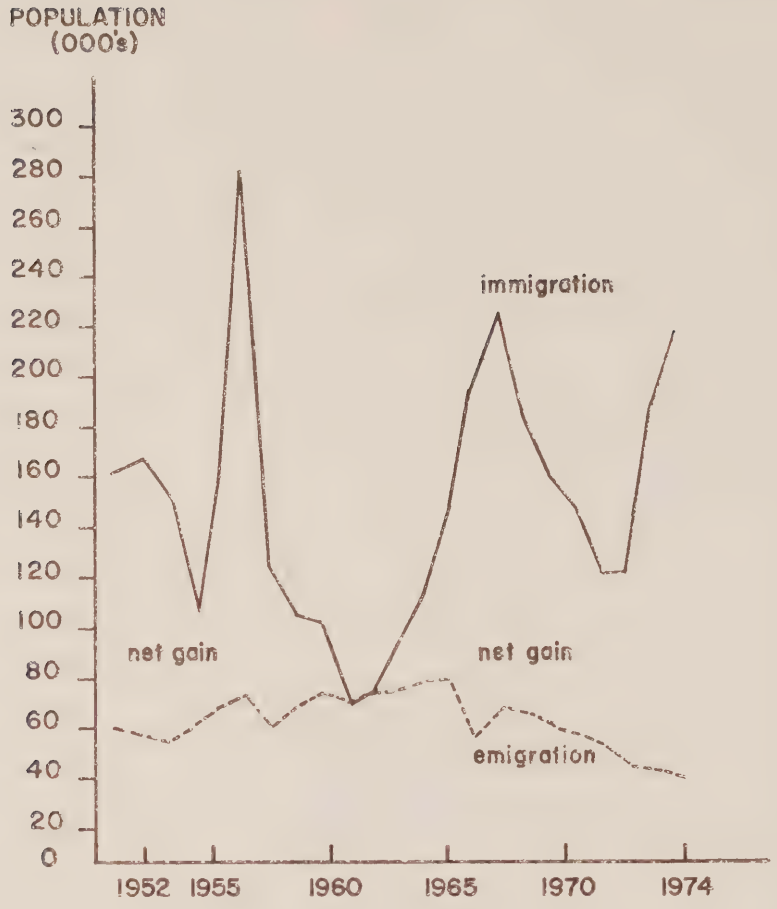


Figure 1.3: IMMIGRATION TO AND EMIGRATION FROM CANADA; 1952 - 1974

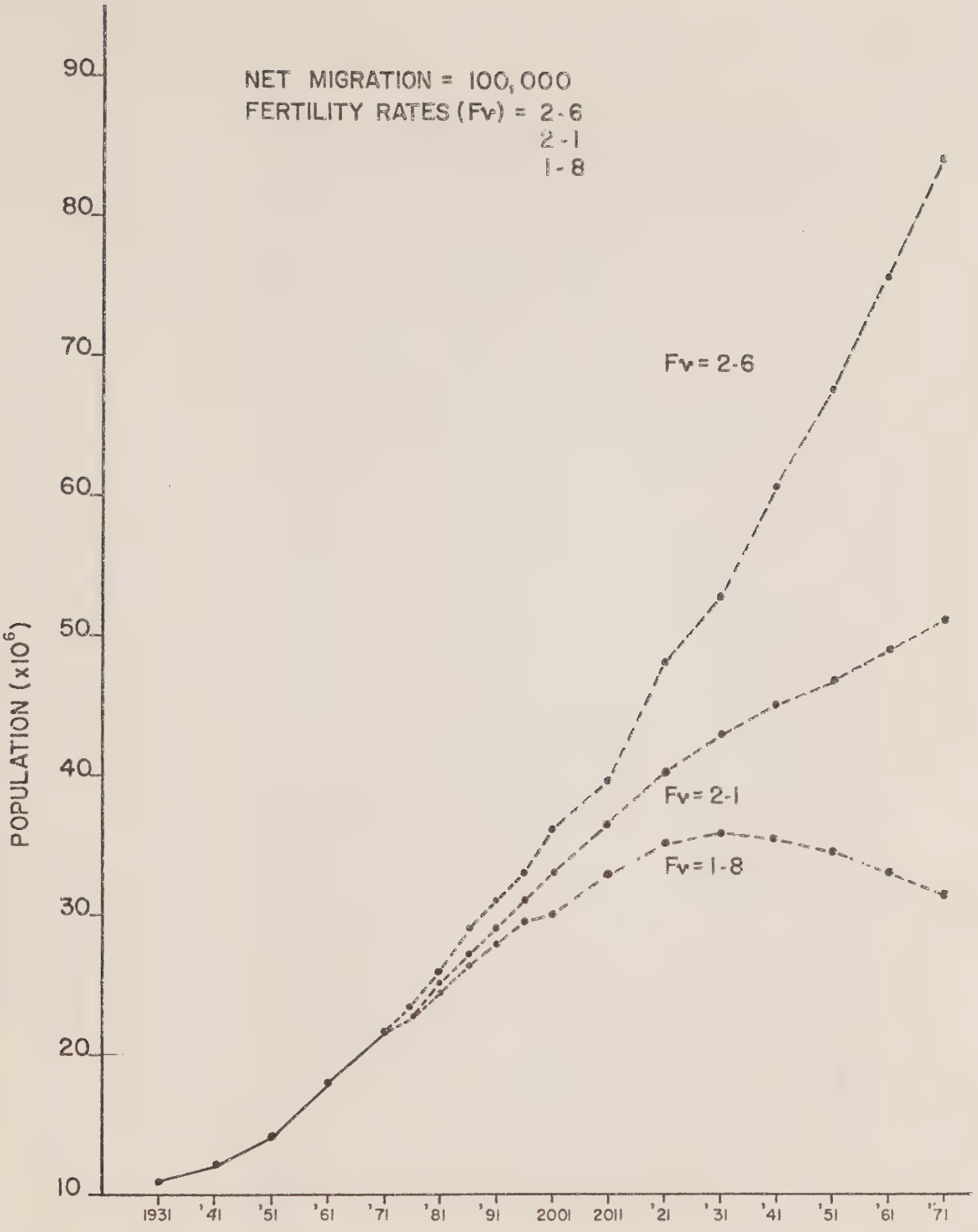


Figure 1.4: POPULATION PROJECTIONS FOR CANADA ASSUMING NET MIGRATION OF 100,000 AND FERTILITY RATES OF 1.8, 2.1 AND 2.6

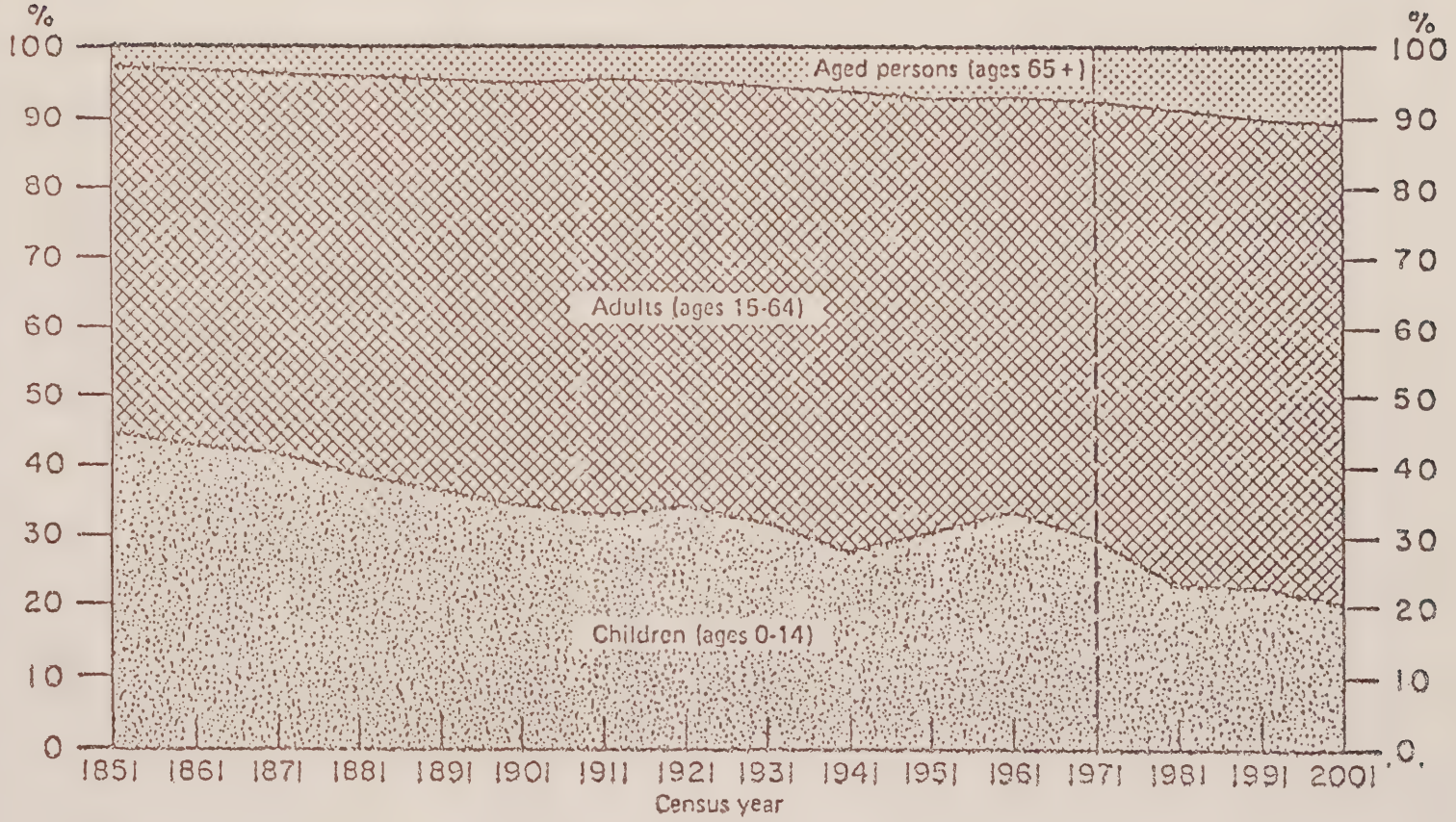


Figure 1.5: PERCENTAGE DISTRIBUTION OF THE POPULATION OF CANADA BY AGE GROUP; 1851 TO 2001

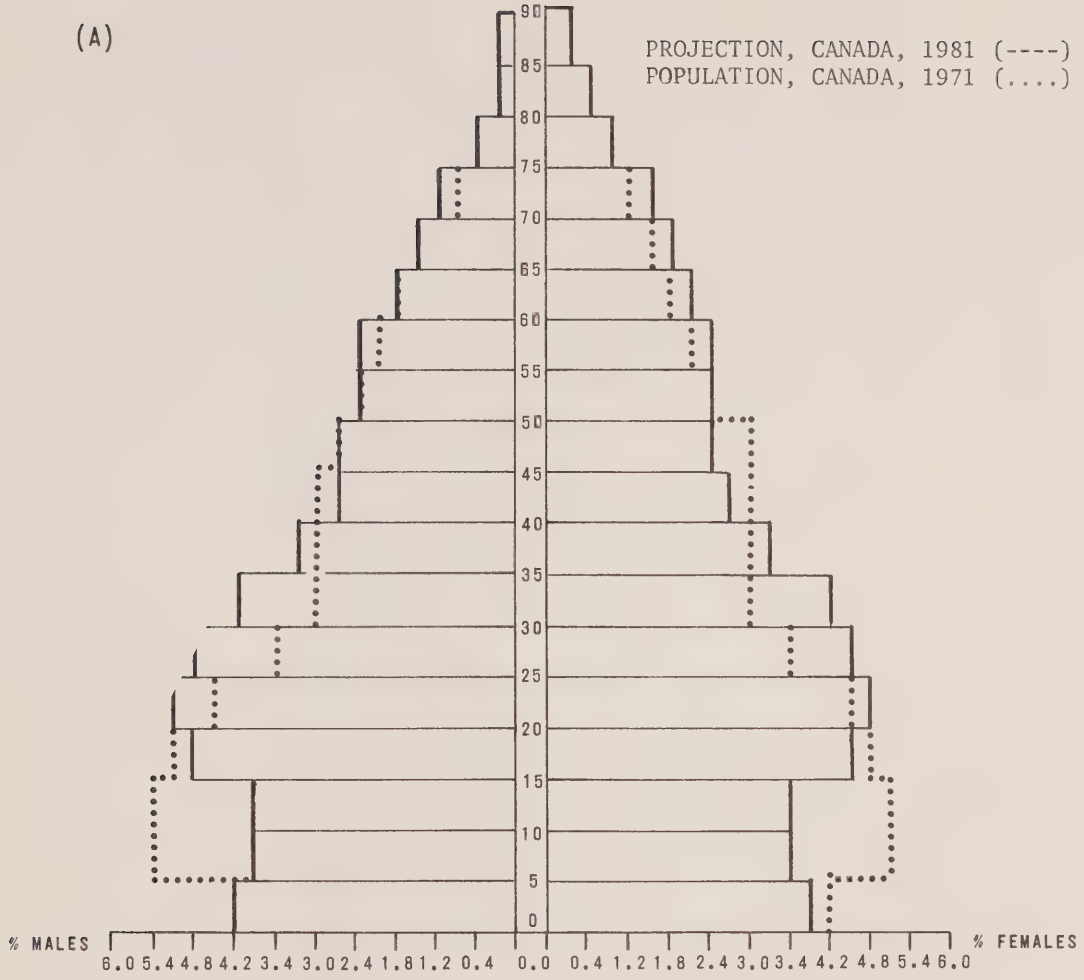


Figure 1.6A: AGE PYRAMIDS FOR PROJECTED POPULATIONS OF CANADA IN 1981

(B)

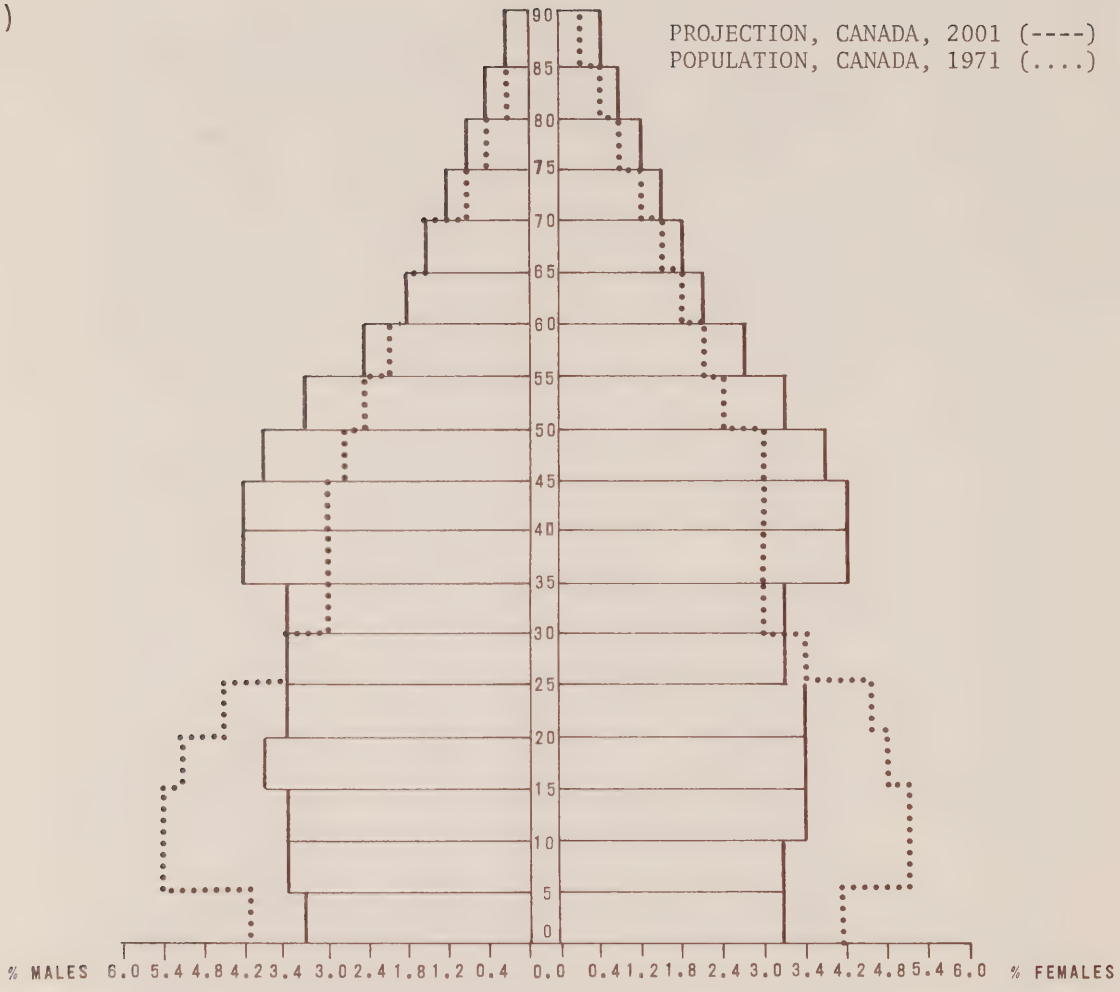
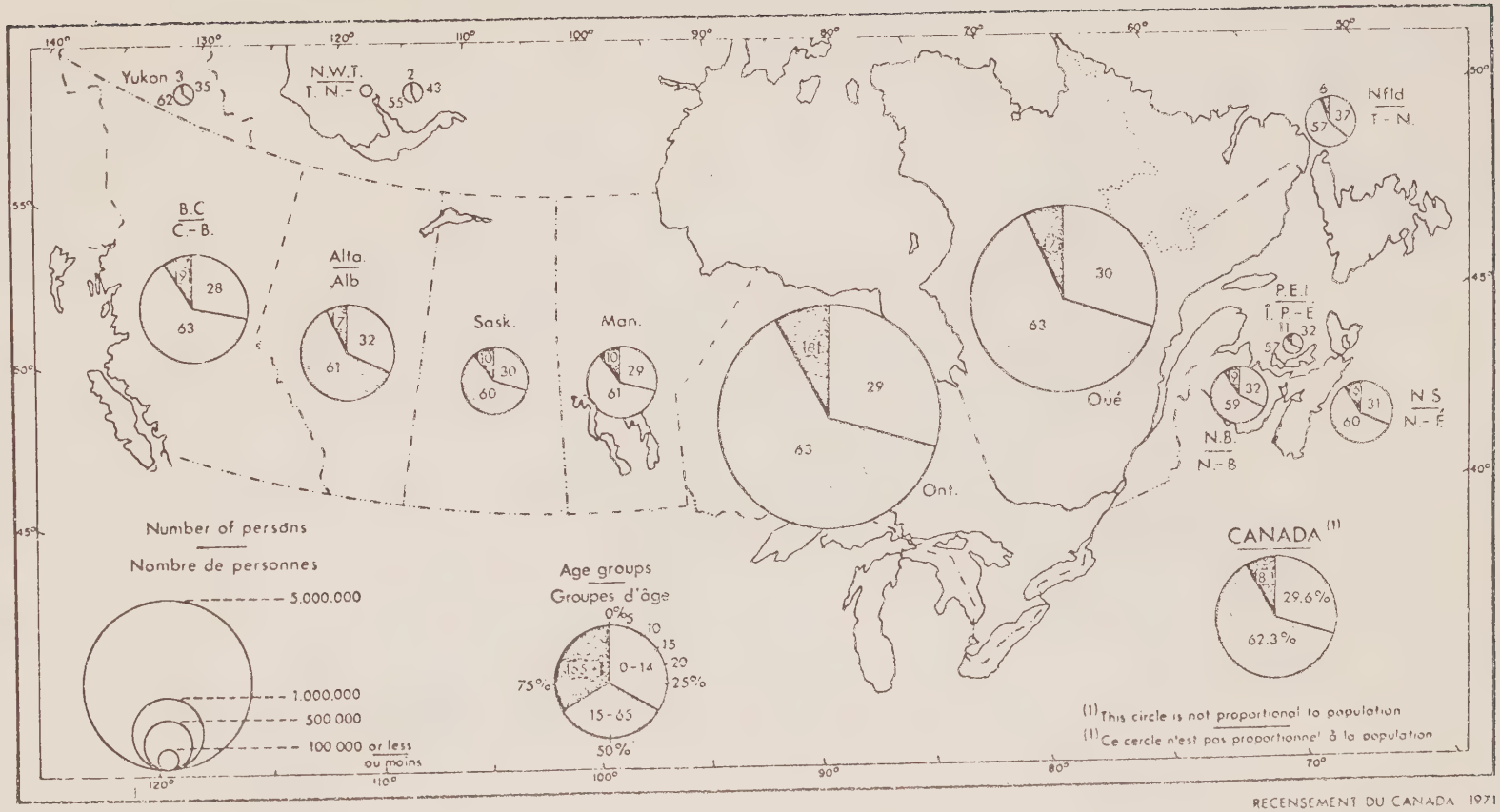


Figure 1.6B: AGE PYRAMIDS FOR PROJECTED POPULATIONS OF CANADA IN 2001



CENSUS OF CANADA. 1971

RECENSEMENT DU CANADA 1971

Figure 1.7: REGIONAL DISTRIBUTION OF POPULATION BY SPECIFIED AGE GROUPS, CANADA AND PROVINCES, 1971

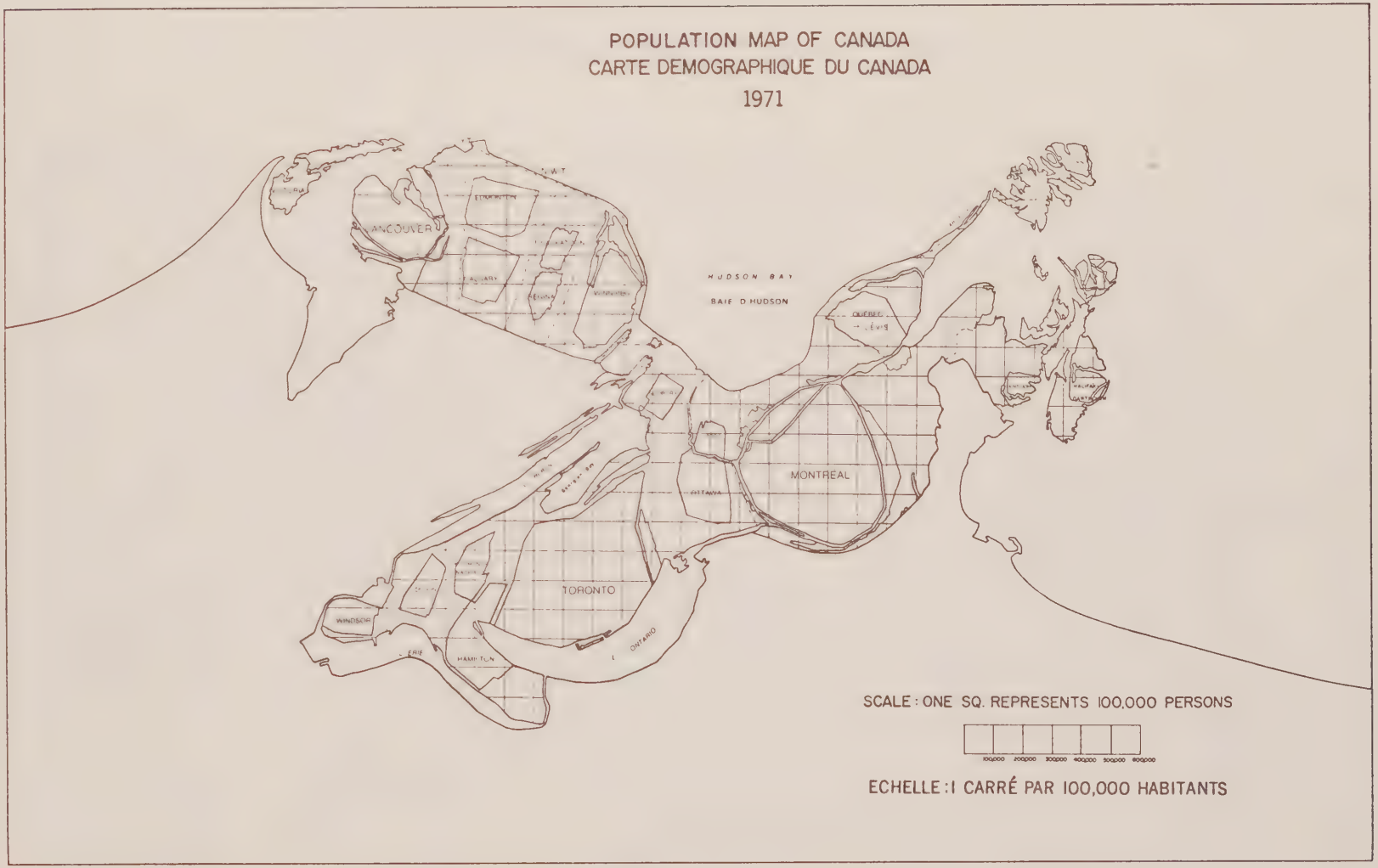


Figure 2.1: POPULATION MAP OF CANADA, 1971

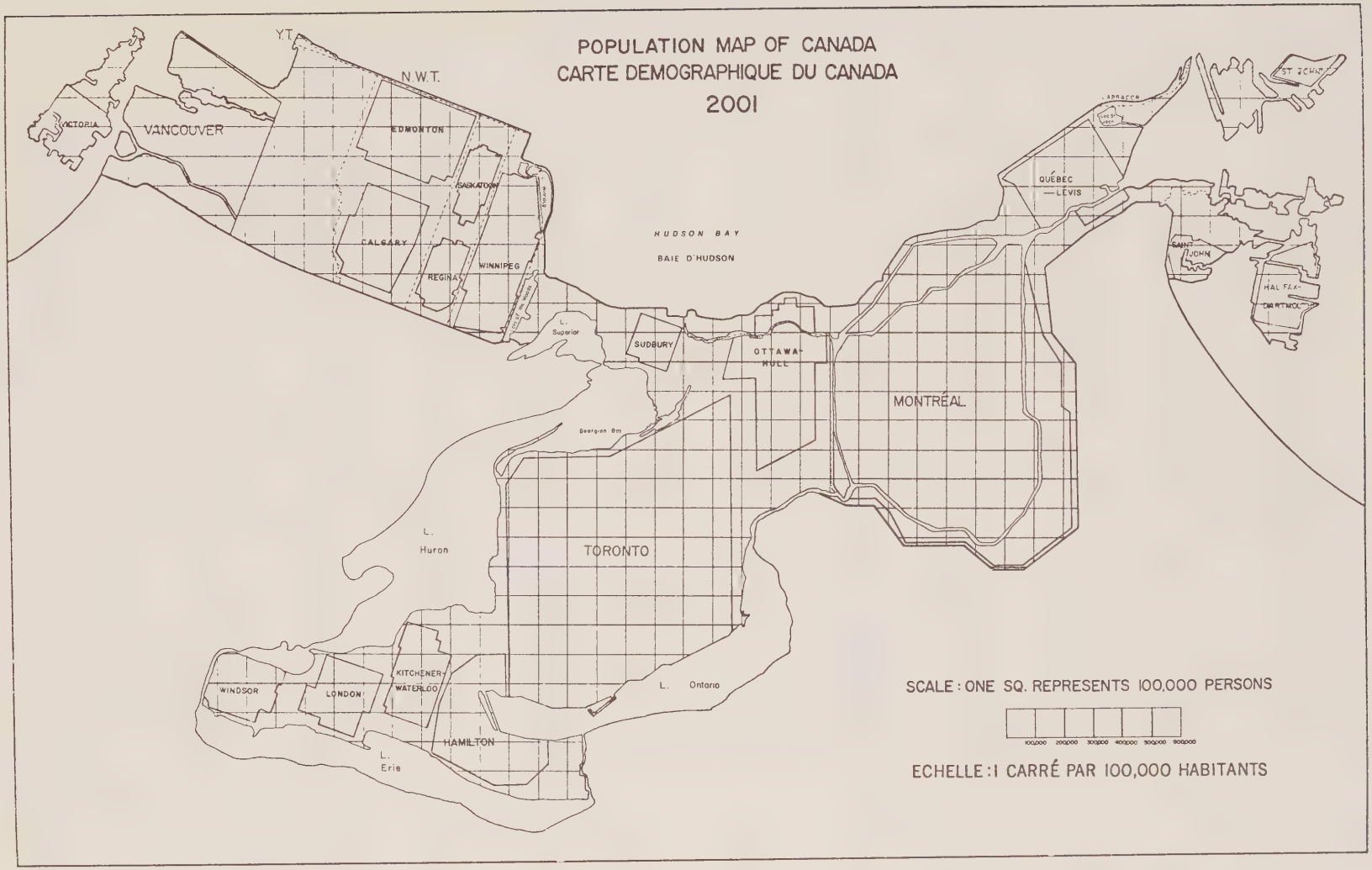


FIGURE 2.2.: POPULATION MAP OF CANADA, 2001

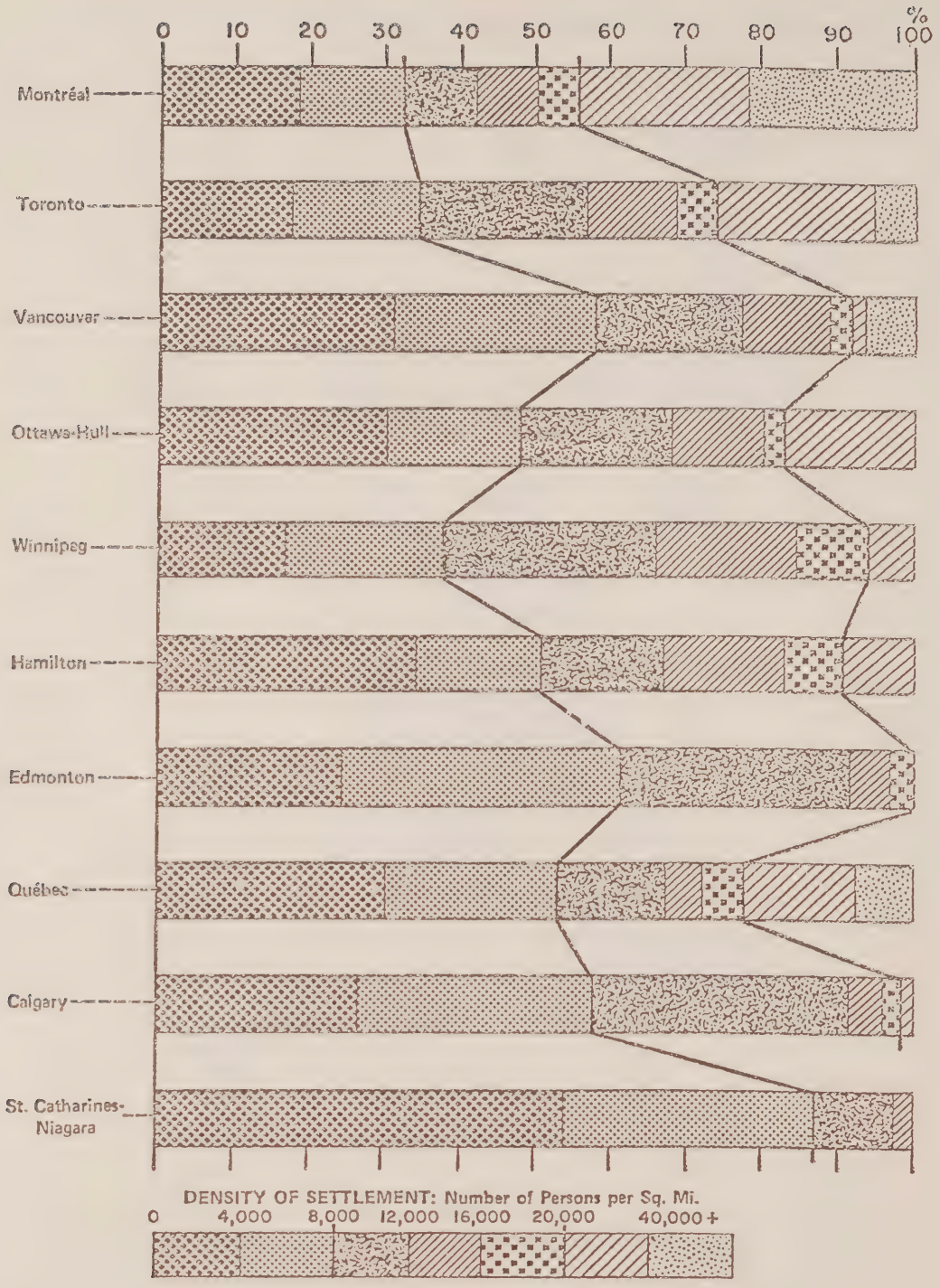


Figure 2.3: POPULATION DENSITIES OF MAJOR URBAN CENTRES: 1971

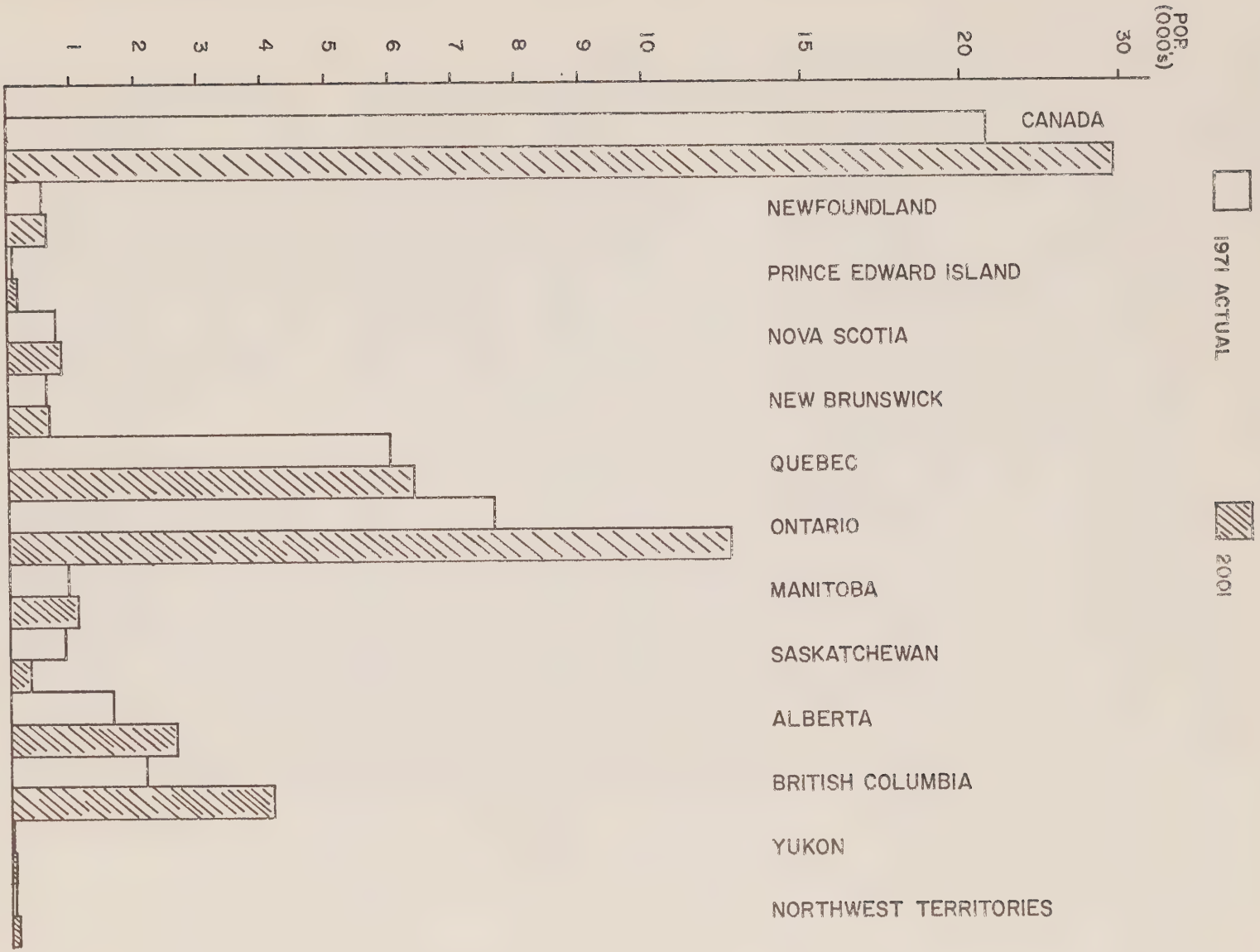


Figure 2.4: CHANGE IN POPULATION BY PROVINCE: 1971 AND 2001

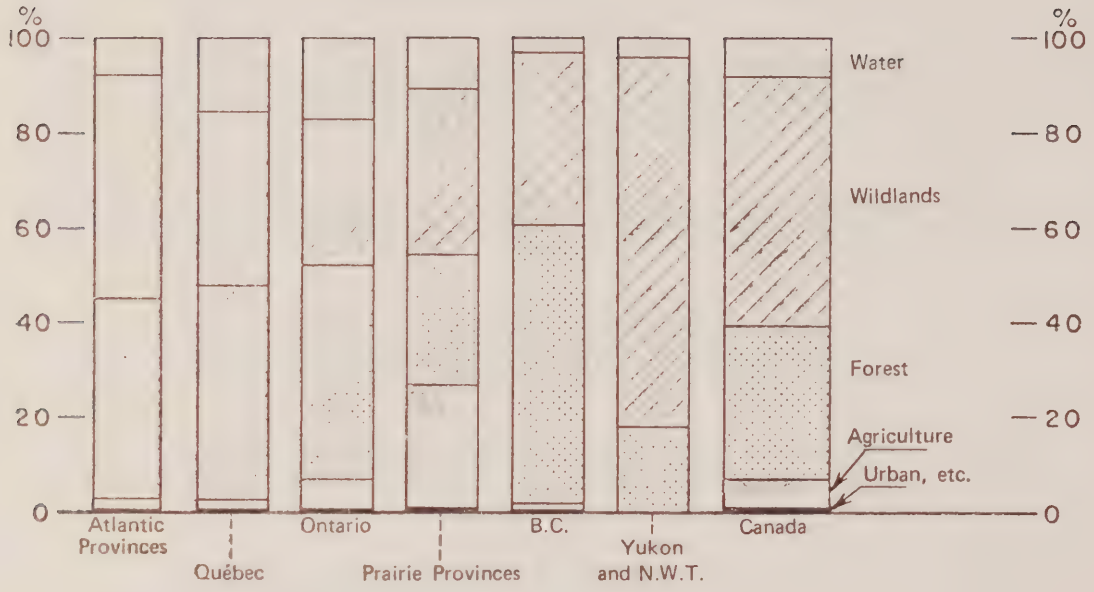
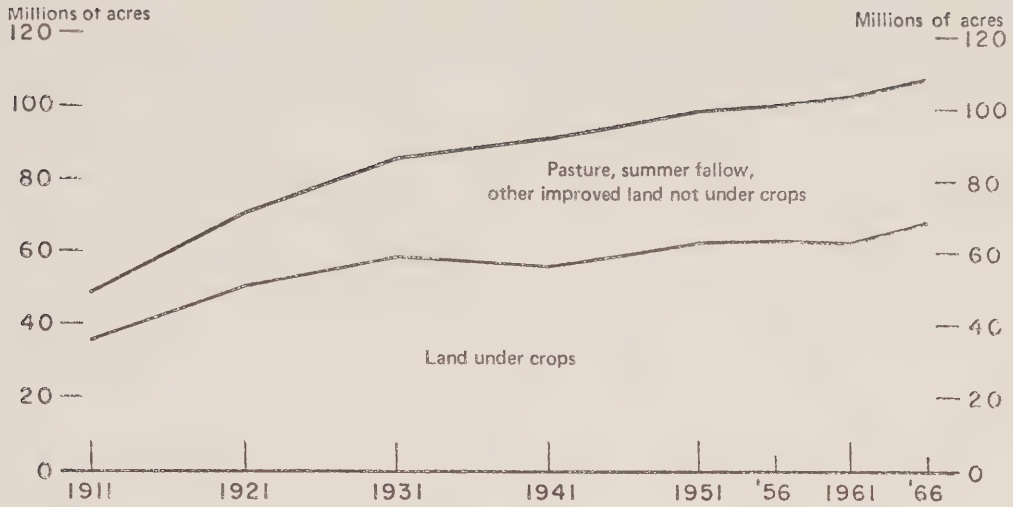


Figure 2.5: LAND USE BY REGION, 1968

Source: Perspectives Canada



1) Total area of all census farms (agricultural holdings of one acre or more with some income from sales of agricultural products).

Figure 2.6: AREA OF IMPROVED FARMLAND (millions of acres)

AREA

POPULATION

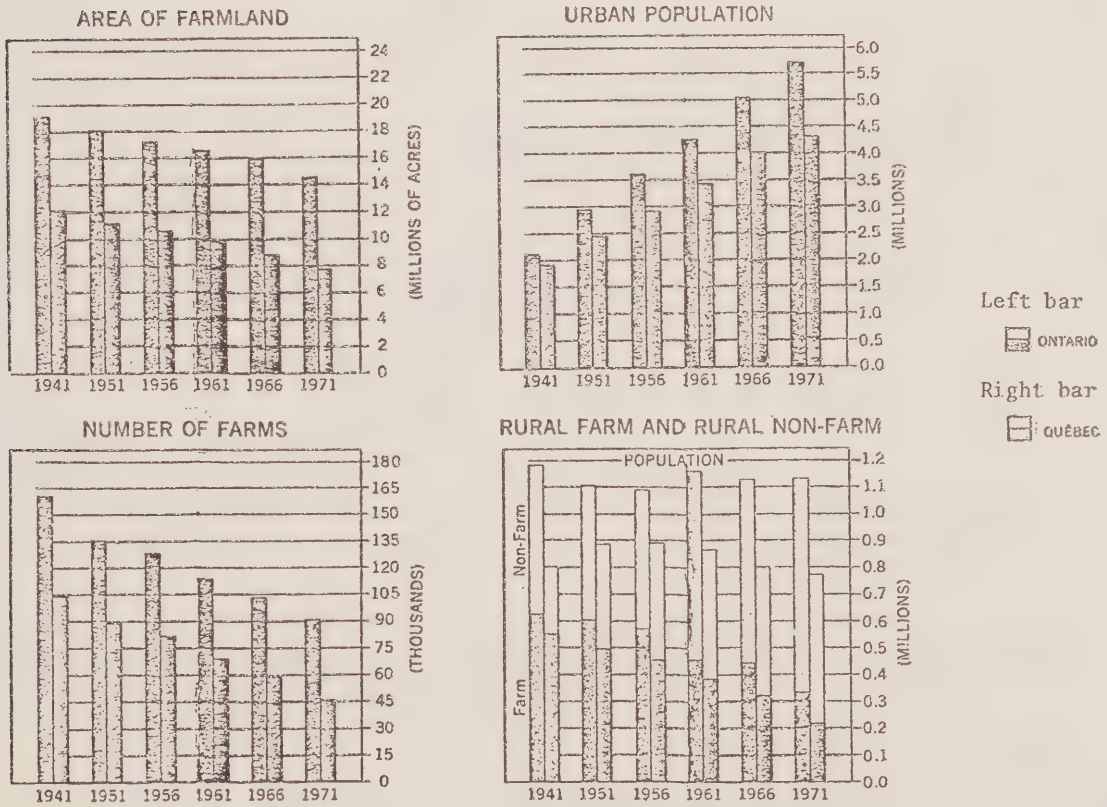
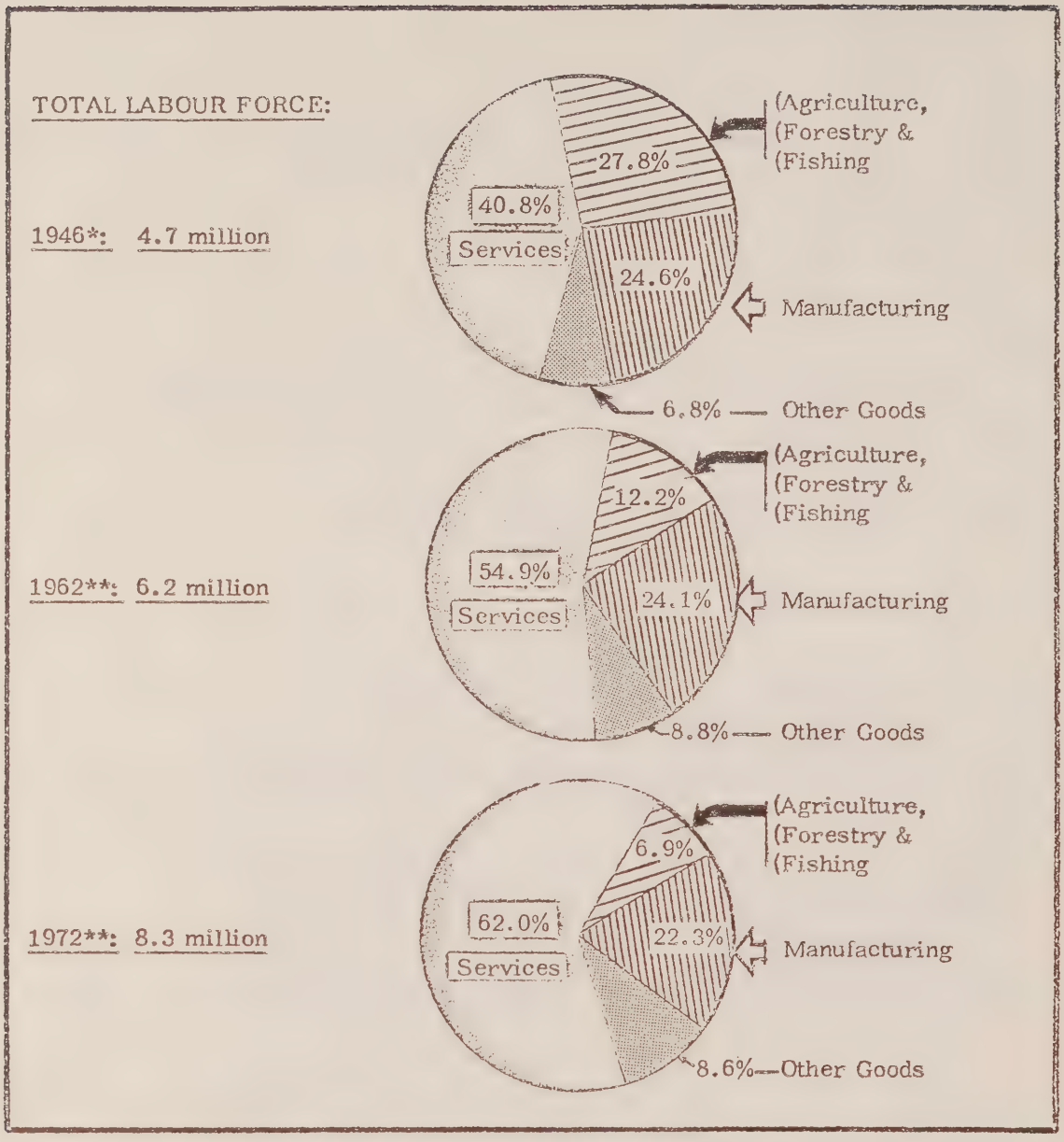


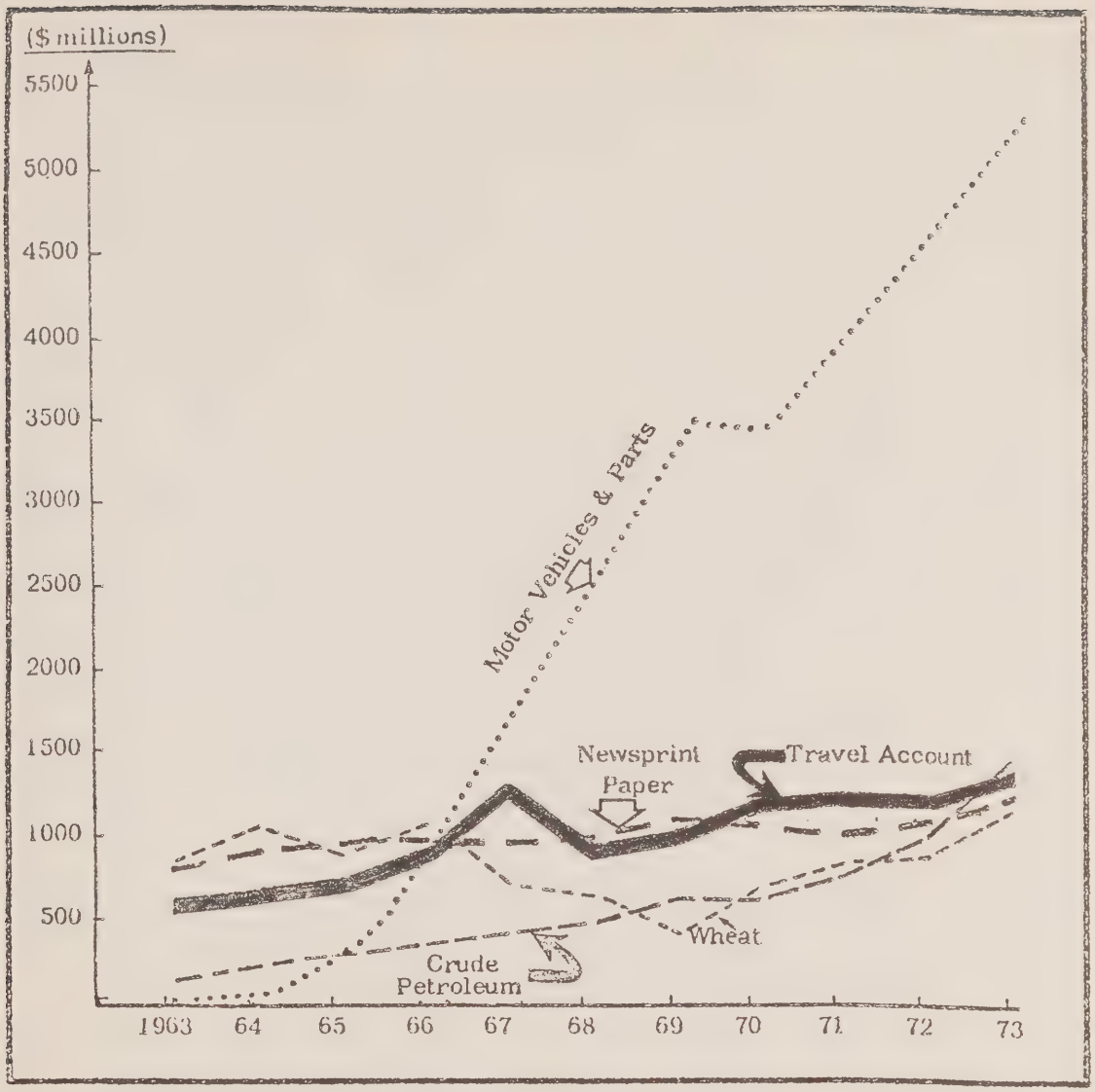
Figure 2.7: URBAN GROWTH IN THE WINDSOR-QUEBEC AXIS: 1941 - 1971



SOURCES: * Patterns of Growth, Seventh Annual Review, Economic Council of Canada, September 1970.

** Current Economic Indicators, March 1973, General Analysis Branch, Office of Economics, Department of Industry, Trade and Commerce, Ottawa.

Figure 2.8: PATTERNS OF GROWTH OF THE CANADIAN LABOUR FORCE, 1946-1972



SOURCE: "Canadian Tourism Facts Book, 1972", Industry Development Branch, Canadian Government Office of Tourism, Ottawa, and Statistics Canada Cat. Nos. 11-003 and 11-505. (April 1974)

Figure 2.9: COMPARATIVE GROWTH TRENDS IN RECEIPTS: FIVE LARGEST CANADIAN EXPORT ITEMS, 1963-1973

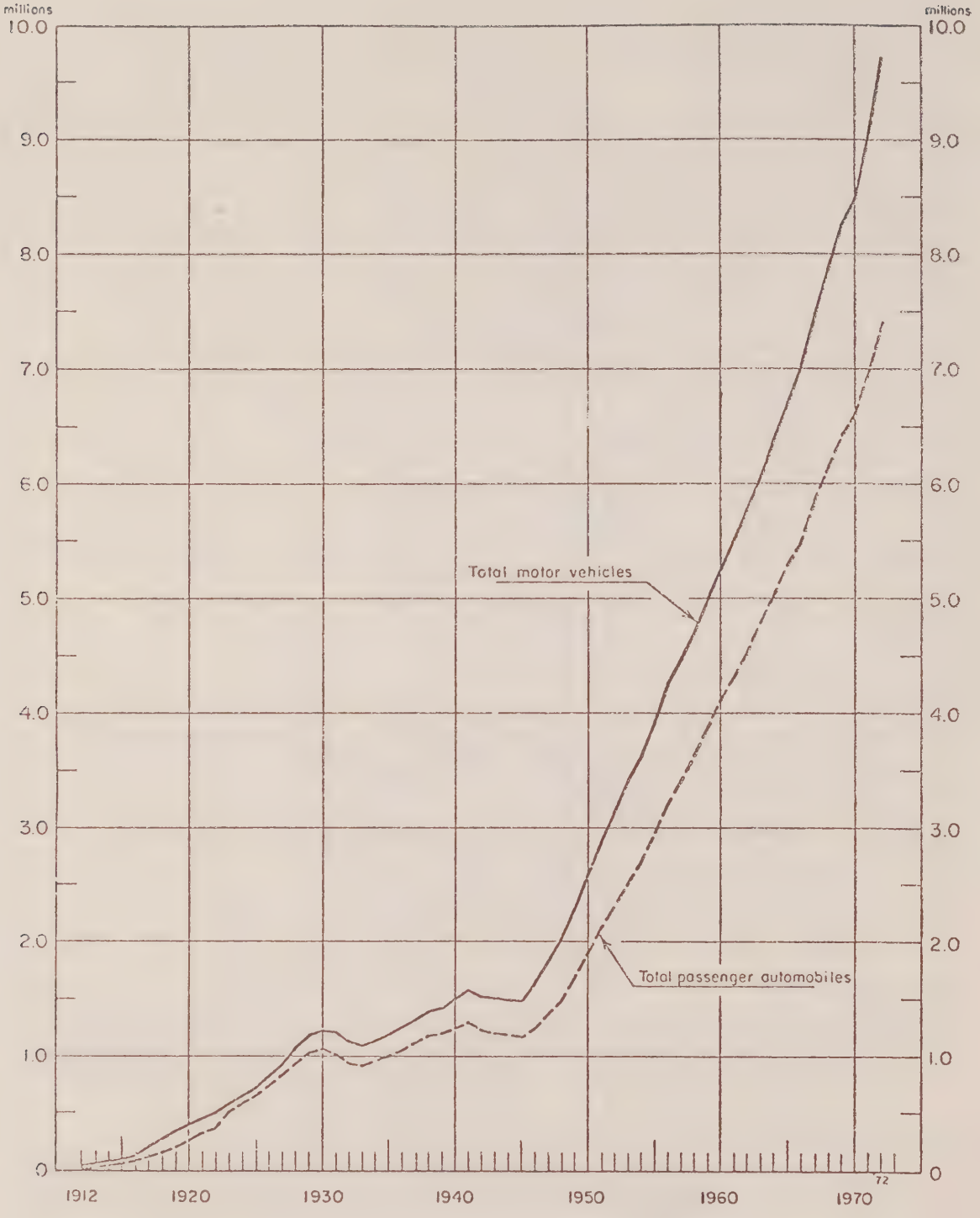


Figure 2.10: REGISTRATIONS OF MOTOR VEHICLES , 1912-1972

Source: Statistics Canada, "The Motor Vehicle Part III" Cat. No. 53-219

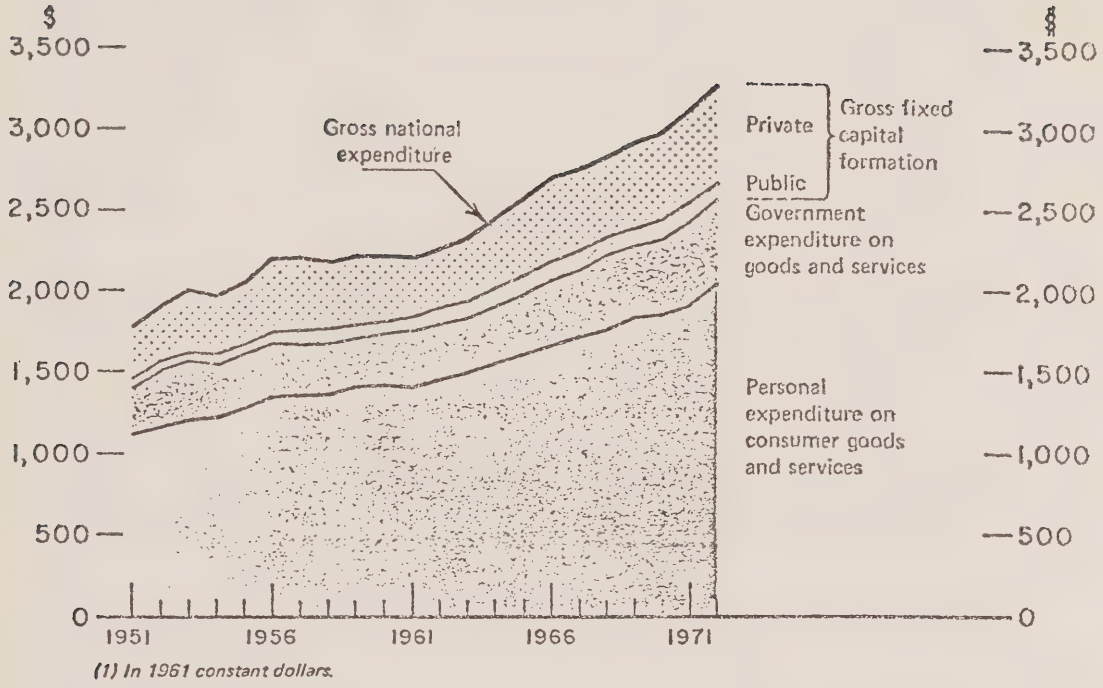


Figure 3.1: GROSS NATIONAL EXPENDITURE (1) PER PERSON

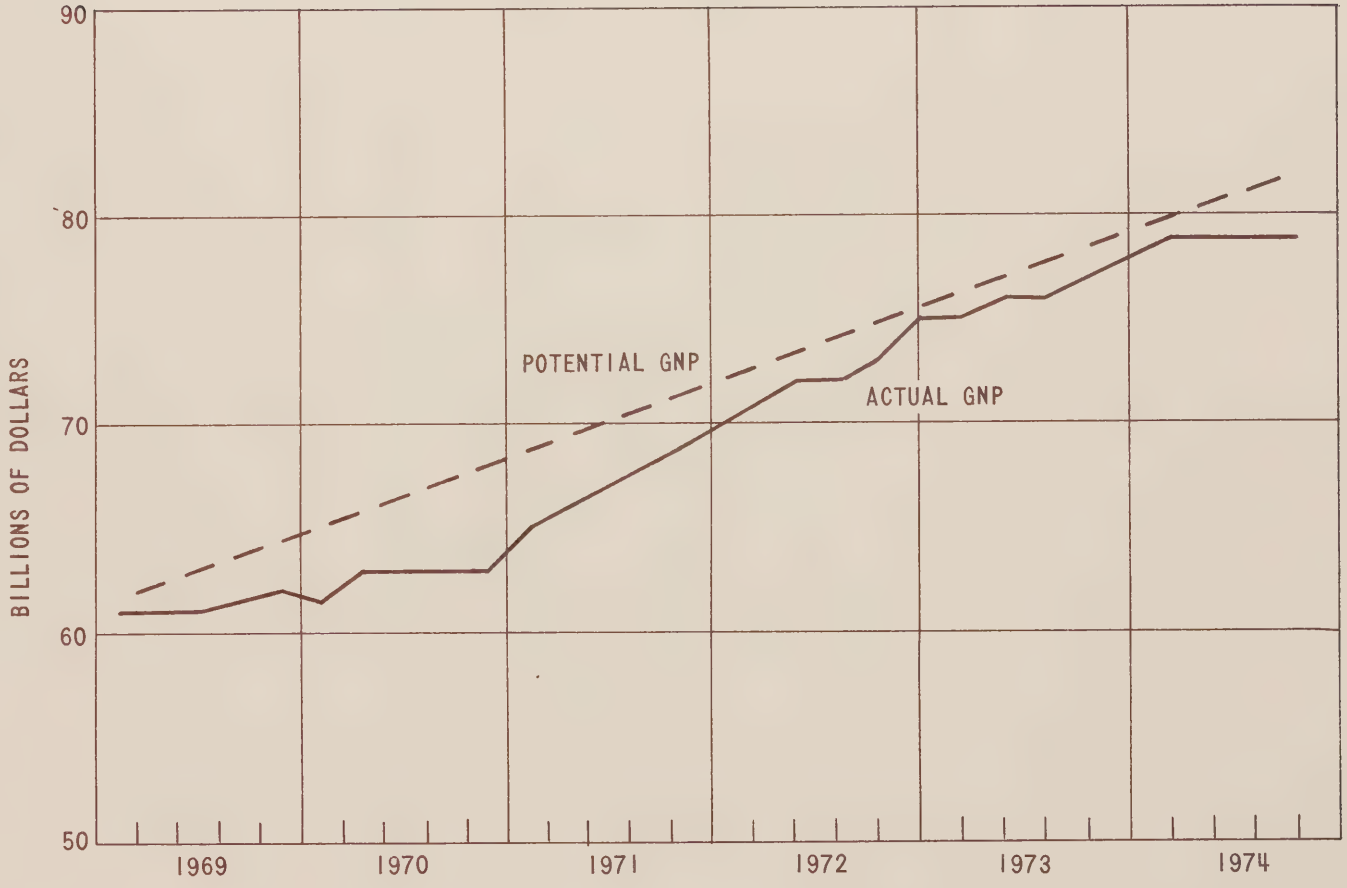


Figure 3.2: POTENTIAL AND ACTUAL GROSS NATIONAL PRODUCT, 1969-1974

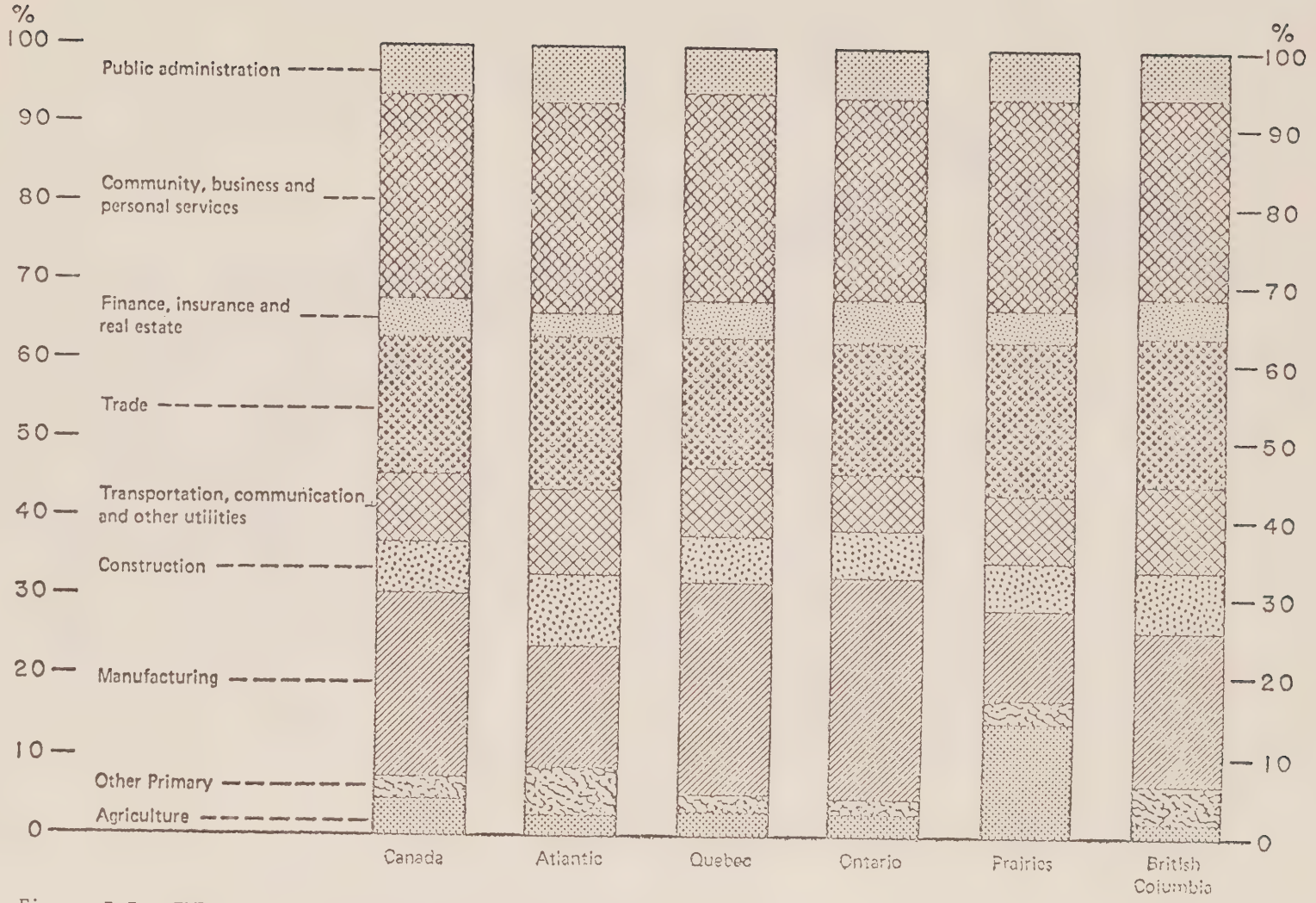


Figure 3.3: EMPLOYMENT BY INDUSTRY AND REGION, NOVEMBER 1973

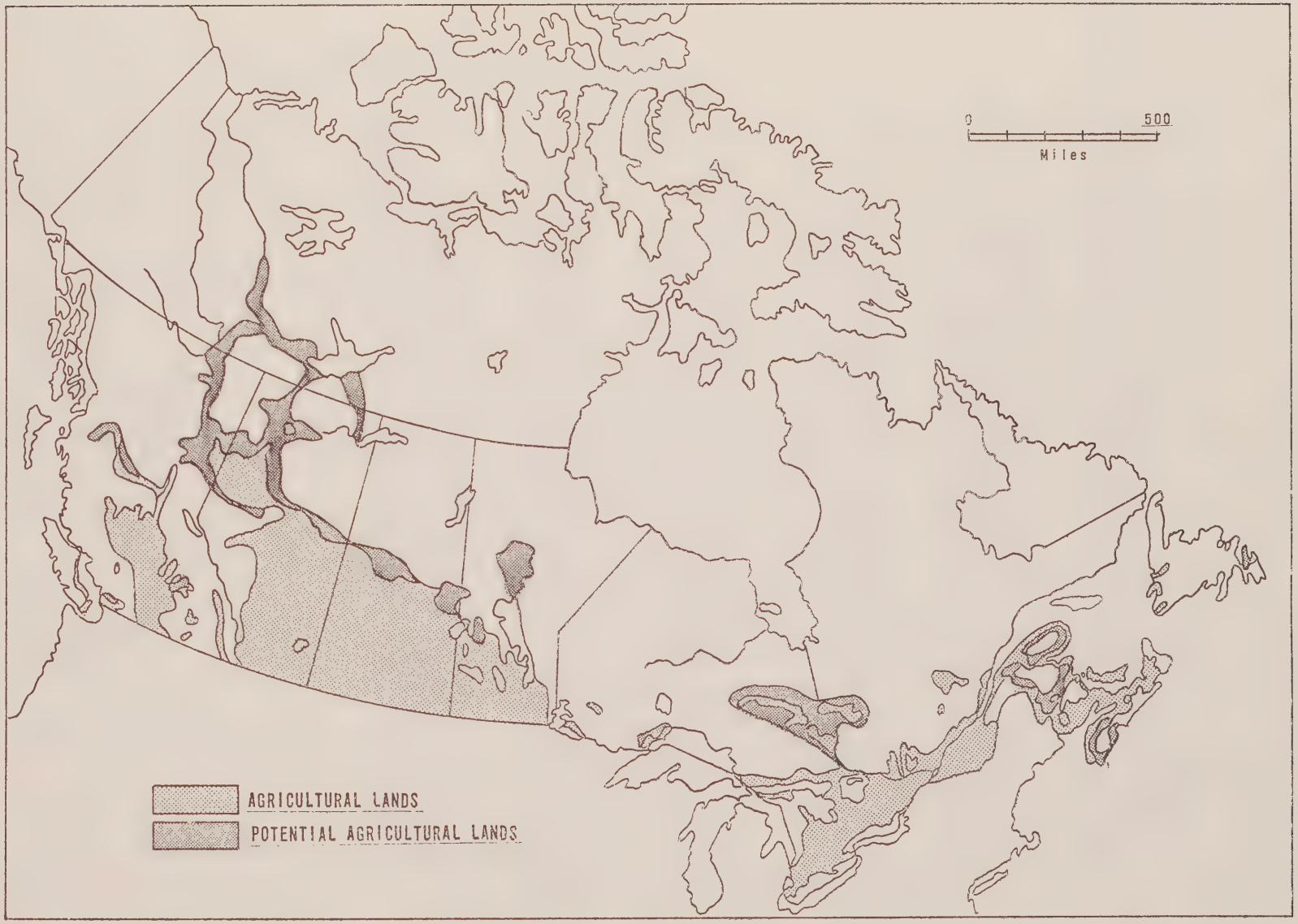


Figure 4.1: AGRICULTURAL LANDS IN CANADA

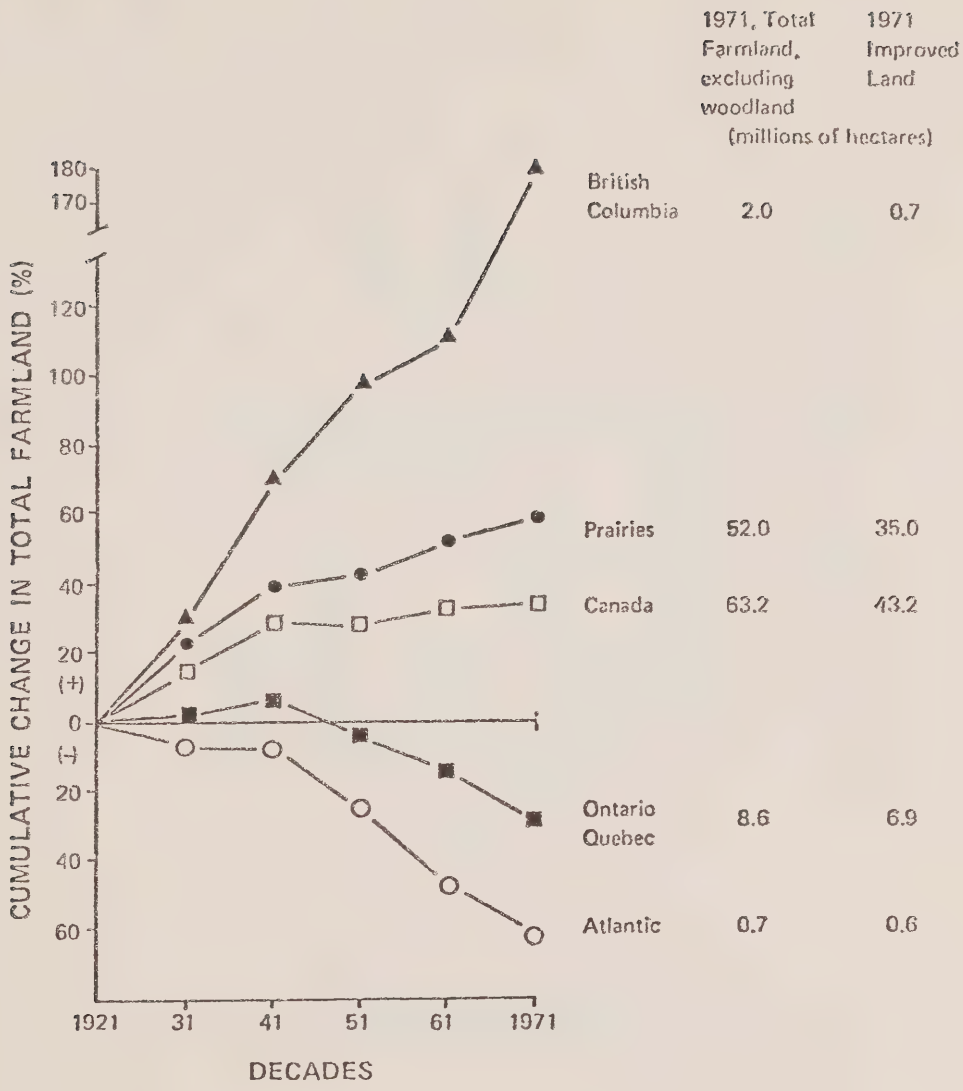


Figure 4.2: CHANGE OF TOTAL FARMLAND (EXCLUDING WOODLAND) IN MAJOR AGRICULTURAL REGIONS OF CANADA

Source: Shields & Ferguson

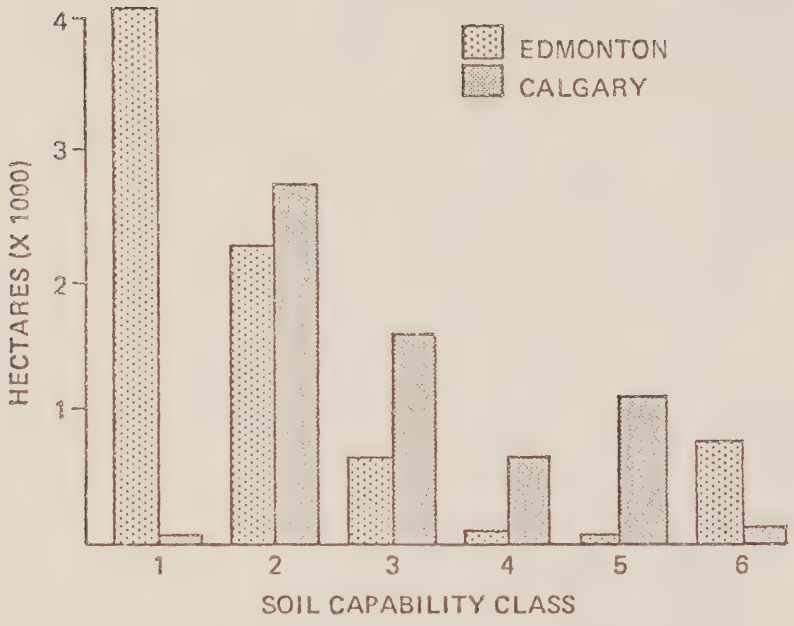


Figure 4.3: HECTARES OF AGRICULTURAL SOIL CAPABILITY CLASSES TAKEN BY URBAN DEVELOPMENT OF EDMONTON AND CALGARY BETWEEN 1966 AND 1973

Source: Shields & Ferguson

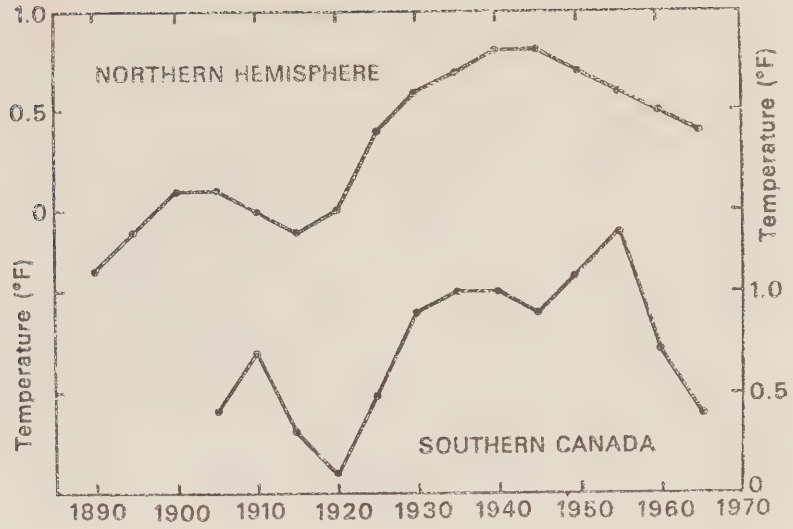


Figure 4.4: TEMPERATURE TRENDS FOR THE NORTHERN HEMISPHERE SINCE 1890, COMPARED TO THE TREND FOR SOUTHERN CANADA SINCE 1905.

Source: M.K. Thomas, Atmospheric Environment Service

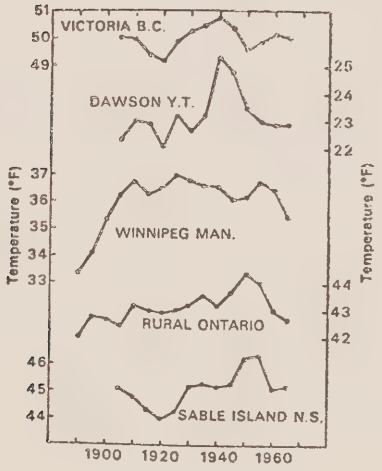


Figure 4.5: TEMPERATURE TRENDS ACROSS CANADA SINCE THE LATE 19TH CENTURY.

Source: M. K. Thomas, Atmospheric Environment Service

Figure 4.6: MEAN ANNUAL TEMPERATURE FOR 2 YEARS 1941 & 1972

Source: Joseph Lai, Office of Science Advisor, DOE
May 1975

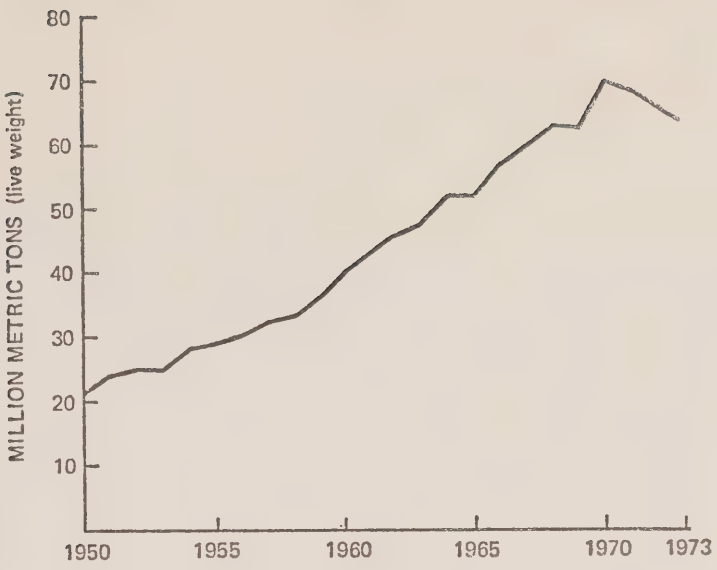


Figure 4.7: WORLD FISH CATCH, 1950-73

Source: Food and Agriculture Organization

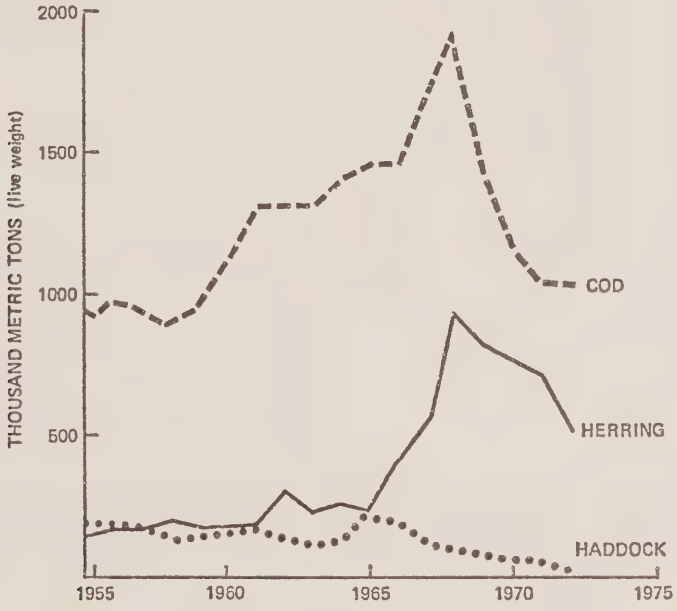


Figure 4.8: ANNUAL CATCH OF SELECTED SPECIES IN THE NORTHWEST ATLANTIC, 1954-72

Source: Lester Brown By Bread Alone

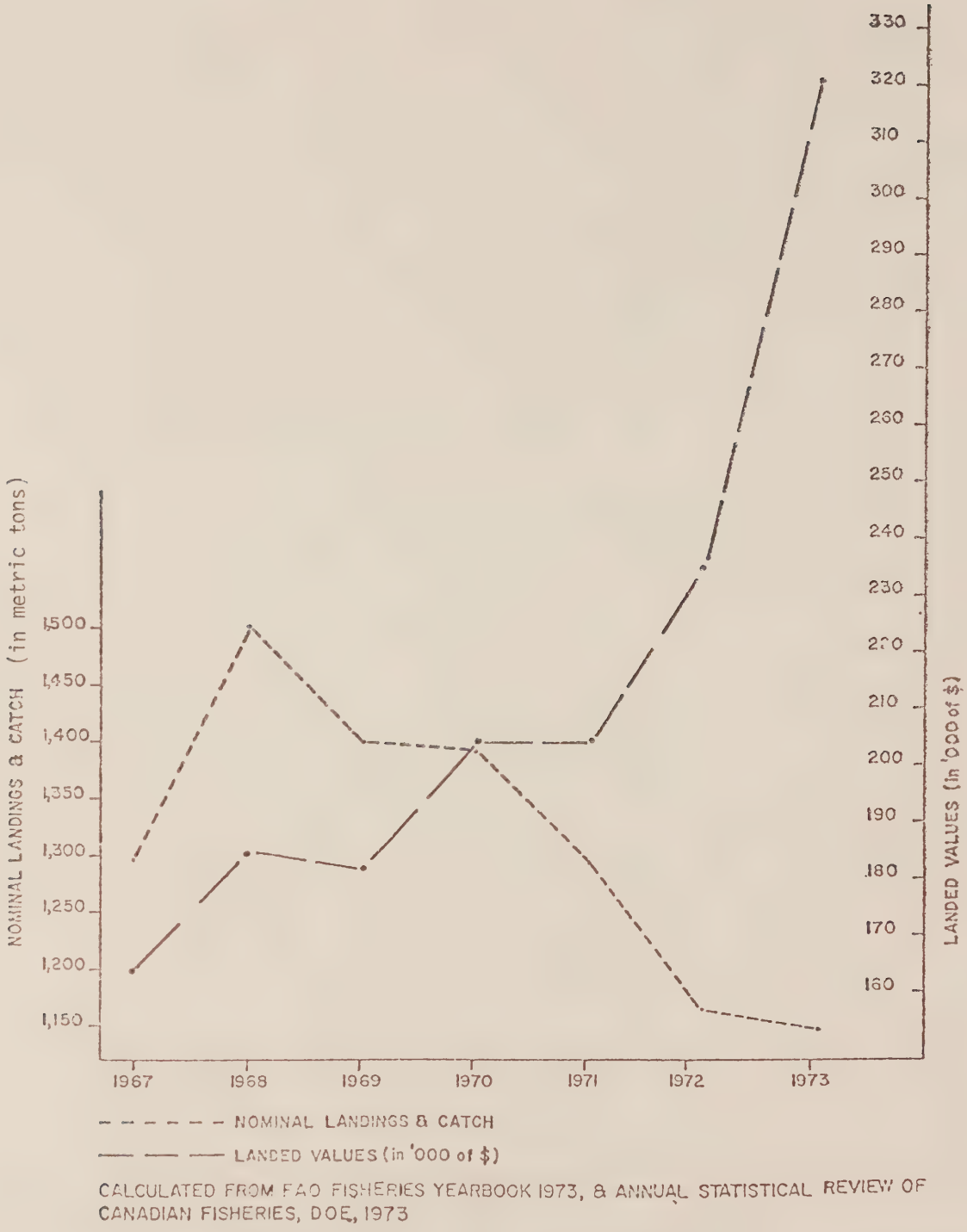
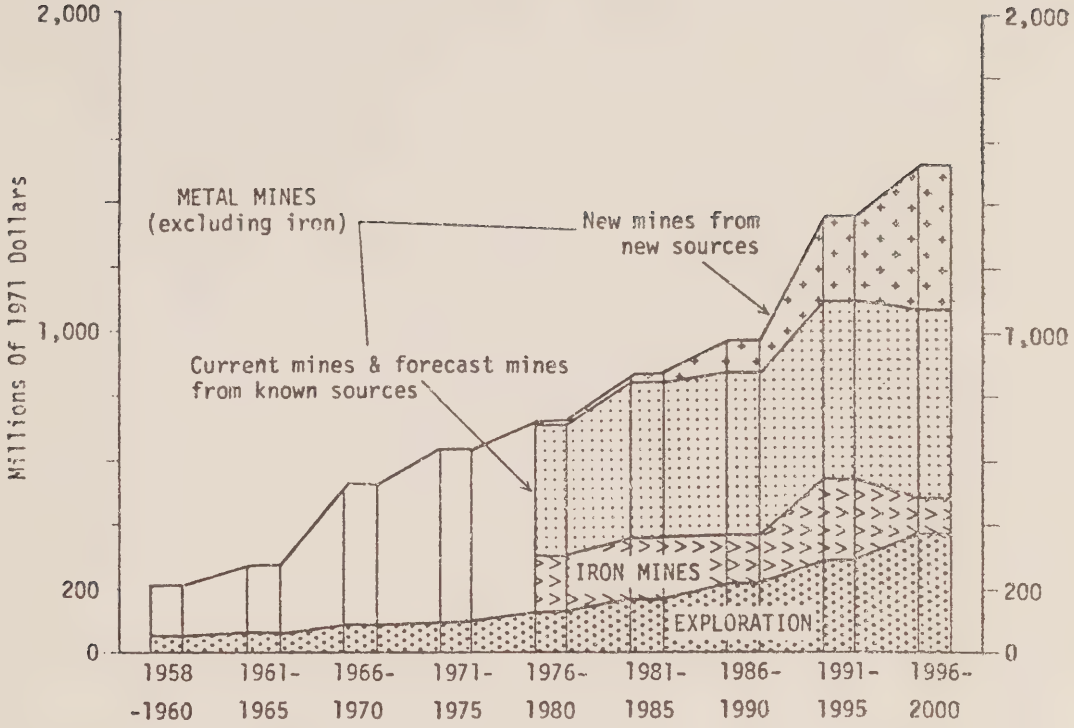


Figure 4.9: CANADIAN FISH CATCH AND DOLLAR VALUE 1967-73



① Investment in machinery, equipment, and structures. Excludes expenditures on infrastructure.

② Consistent investment statistics prior to 1958 not available.

Figure 4.10: ESTIMATED AVERAGE ANNUAL CAPITAL INVESTMENT[1] REQUIREMENTS AND EXPLORATION EXPENDITURES FOR METAL MINING, 1958[2]- 2000

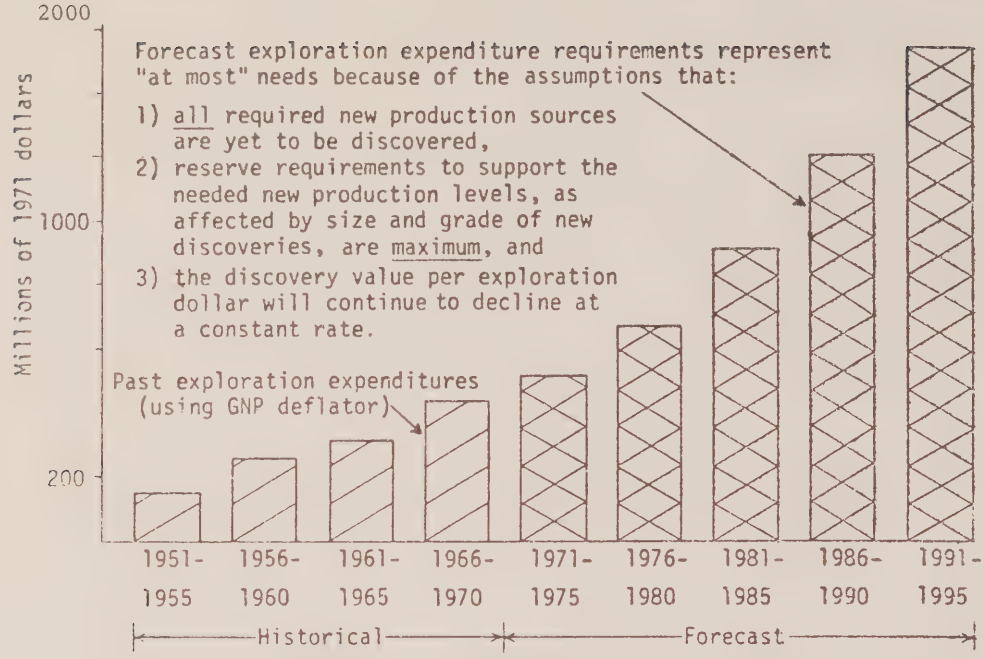


Figure 4.11: EXPLORATION EXPENDITURES, 1951 - 1995 (By 5-year Period)

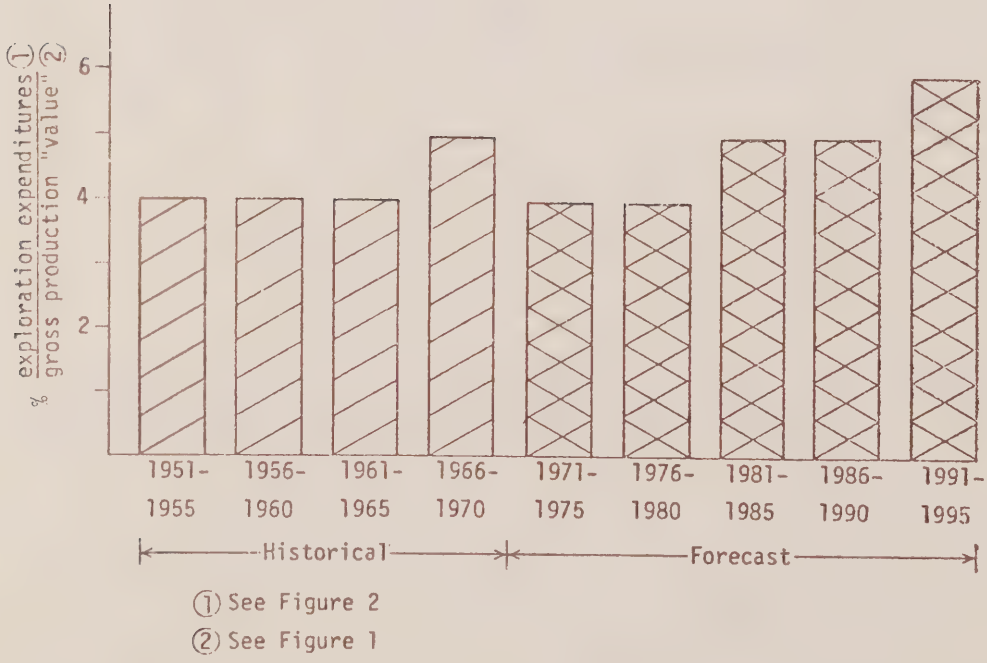


Figure 4.12: EXPLORATION EXPENDITURES[1] EXPRESSED AS A PERCENTAGE OF GROSS PRODUCTION "VALUE"[2] 1951 TO 1995

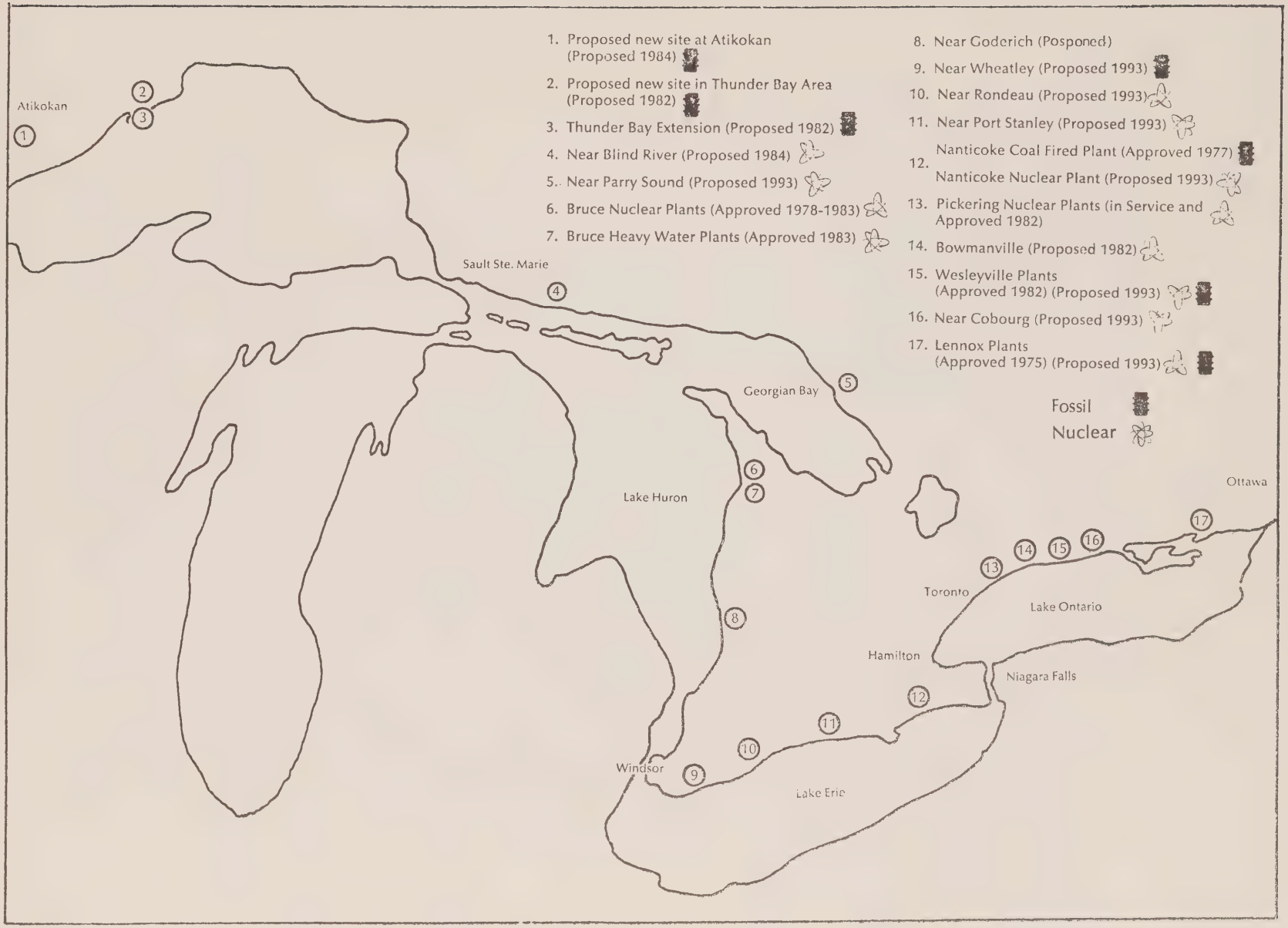


Figure 5.1: APPROVED AND PROPOSED HYDRO STATIONS IN ONTARIO. 1974-93.
Source: Pollution Probe, University of Toronto

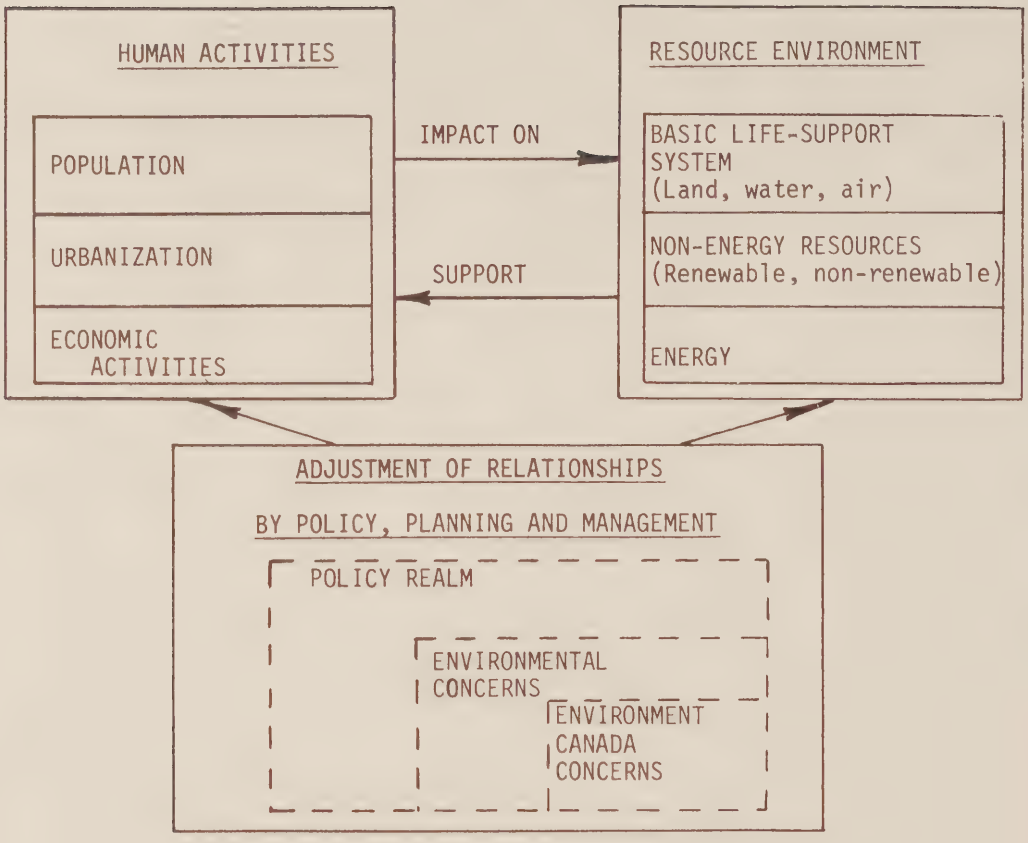


Figure 6.1: RELATIONSHIP BETWEEN HUMAN ACTIVITIES AND THE RESOURCE ENVIRONMENT

Appendix D: A HYPOTHETICAL MIXED ECONOMIC GROWTH ALTERNATIVE, 1975-2000

This alternative uses elements of various growth trends (low, medium, high), spaced over the 1975-2000 period.

The basic assumption is that high resource development and demand takes place, with a small population growth. The development of the resource sector would occur mostly in the 1975-1985 decade (6% annual increase in real GNP), followed by slowing growth rate of about 4.5% by 1995-2000. The average rate of growth between 1975-2000 would be 5.3%.

Such a trend would have the following possible features (using 5-year segments from 1975):

(1) In the 1975-1979 period, the economy would come out of the current recession and enter into a period of energy resource development stimulated by high energy prices. But difficulties and bottlenecks regarding availability of development resources would prevent the realization of developmental intentions during this period. By the end of the 1970's, the resource development expansion would be well-launched, but would not yet have reached its peak. Secondary manufacturing will have begun to feel the pinch, but will still register gains close to the levels of the pre-recession 1970's.

(2) The succeeding period, 1980-1984, would be characterized by wide-spread resource development. The rate of growth would be well beyond the Economic Council projections (c. 6 per cent). Full employment would be achieved. Increased internal migration, immigration from abroad, and domestic programs to expand the labour supply would be called for to ease manpower shortages.

While development investment would occur at a high rate (funded both from domestic and international sources), government social expenditures and transfer payments would be growing quite slowly as the dependency ratio decreases and the employment level reaches 96 per cent. By the mid-1980's, infrastructure developments (related to needs of energy and resource developments) projected in the 1970's will be nearing completion and new projects would be underway. Towards the end of this period, the rate of construction activity would begin to slow down. Secondary industry would have had great difficulties during this period, (i.e. capital and manpower shortages) except for firms associated with resource development.

(3) The late 1980's would be a period of catching up for some sectors that have lagged behind resource development; the rate of growth of real GNP would decline to the levels of the late 1970's. Marginal shifts of population would begin to occur, favoring those areas near resource developments. Higher real income levels generated by the developments of the 1980's would lead to a very strong domestic market for consumer durables and leisure-recreational services. The supply situation for secondary manufacturing would begin to ease and there would be serious consideration of the possibility of technological upgrading and changes in the amount of capital concentrated in this sector.

(4) In the early 1990's, a more "mature" economy would settle into a period of more moderate growth (c. 5 per cent real growth per year). Domestic demand would still be strong, but the level of demand for durables might slacken and give way to a growing consumption of services. An increase in the rate of government expenditure might occur, particularly at the provincial and municipal level. This probably would relate to new or expanded communities around resource areas deciding to upgrade their infrastructure and level of services. There might also be renewed interest in development of new types of public services, unanticipated in the 1970's, and in increased aid to other countries. It would not be unlikely for a renewed wave of concern to manifest itself regarding anticipated resource shortages and pressures for extended development and application of environmental planning.

(5) The last five years of the century (1995-2000) could show further levelling of the rate of growth, to levels below the averages of the 1950's and the 1960's. Real GNP would be growing at an average annual rate of 4.5 per cent, as the economy would continue to mature and the population would continue to age. Rates of public expenditure would begin to increase at a steep rate once more, in anticipation of further needs of an aging "baby boom" generation. As the century ends, Canadians would once more debating the question of the country's further development and would begin to question whether the boom of the 1980's was, in fact, as desirable as it appeared to be at the time.

Thus, by the year 2000, according to this growth path:

(1) The level of real GNP would be about 3.6 times that of the mid-1970's;

(2) Depending on the size of population (between 30 and 35 million), real GNP per capita would range between 2.3 times and 2.7 times the 1975 level. In terms of 1975 dollars, this would amount to between $15,835 and $18,590; in terms of constant 1961 dollars, the range would be between $8,080 and $9,500;

(3) By the year 2000, Canada could expect to have a well-developed second industrial base and core area of population, largely in Alberta and British Columbia;

(4) Depending on the way in which it would handle the challenges of transition, secondary manufacturing would likely be more diversified, more technologically sophisticated, and much more viable than in the mid-1950's. It would represent a declining sector of employment and would be characterized by increased capital intensivity;

(5) Proportionately, Canada would be more oriented to its domestic economy than it was in the early 1970's, though the absolute value of exports would have expanded with the general expansion of the economy;

(6) Government expenditure, after having grown, proportionately slowly during the 1980's, would be on the rise again. Social expenditure would be directed towards the senior population as well as to new programs. A higher share of public expenditure would likely be administered by provincial, municipal and inter-regional authorities.

Appendix E: PRODUCTION OF THE DOCUMENT

The draft version of the document (Sept. 1975), was reviewed and discussed with the Services and Regions of Environment Canada before the final December, 1975 edition was issued. In addition, copies were sent for reviewing to the Economic Council of Canada, National Health and Welfare Canada, Privy Council Office, Treasury Board and Ministry of State for Urban Affairs.

The draft and final versions of the document were produced by a team within Environment Canada. The team coordinator was Mr. B.W.G. Marley-Clarke of the Policy Branch, Planning and Finance Service. The basic team consisted of Ms. J. Tait (Chaps. 1, 2 and 4), Robin Lee von Geier (Chaps. 1 and 5), and Dr. H.S. Weiler (Chaps. 2, 3, 4, 5 and 6; coordination of editing and physical production). Contributions were also provided by Mr. B. Emmett (Chap. 3), Mr. T.L. de Fayer (Chap. 5), Mr. A. Hughes (Chap. 5), Mr. R. MacKay (Chap. 2), Mr. G. Thornburn (Chap. 4), all of Environment Canada, and Dr. S.N. Silverman of Kanata, Ontario (Chaps. 3 and 6). The final document represents 2.3 man-years over the calendar year 1975.